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UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION

MICROELECTRONICS MONITOR

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No. 17 January - March 1986

Dear Reader,

Our activities during the first quarter of 1986 revolved around two main programmes: a workshop was held at Sidi Bel Abbes, Algeria in January, which was a joint effort of UNIDO, the Economic and Social Commission for Western Asia (ESCWA) and the Government of Algeria. Discussions centered on the question of establishing a silicon foundry with design centres in the region and the meeting agreed that this should be pursued in an evolutionary manner at the same time setting up a network of national centres. More on this inside this issue.

The recommendations of the expert who visited eight member countries of REMLAC, the Latin American Regional Microelectronics Network established with the help of UNIDO in 1985, are now under examination by REMLAC focal points. The UNIDO expert looked at the possibility of strengthening negotiating capabilities in the region concerning acquisition of hardware and software and a concrete programme of action was elaborated and proposed to the focal points.

Another element, common to activities in both regions relates to design and fabrication of multi-project chips. UNIDO has contacted international leading experts on this subject and encouraging replies have been received from scientists in Australia, Belgium, Canada and the USA. It is their opinion that a multi-project chip activity could be the tool for strengthening technological capabilities in the field of design of custom and semi-custom chips.

We hope to introduce an innovation in the next issue in the form of a Round Table on the multi-project chip. We are writing to several institutions with experience in the implementation of the multi-project chip and their replies will be published in the next issue under the Round Table column. Comments will be invited from readers which will be published in the following issue. The intention is to focus and stimulate debate on a particular subject involving experts in the field and the readers of the Monitor. If the experiment is successful, the Round Table could become a regular feature each time on a specific subject involving in due course enterprises as well.

Replies on the questionnaire attached to issue No. 16 have started to arrive. They will be reviewed carefully and suggestions, to the extent possible, will be taken into account.

Compiled by the Technology Programme of UNIDO P.O. Box 300, A-1400 Vienna, Austria

In view of our resource constraints, we are also considering ways and means of reducing costs. In future, the number of pages may have to be reduced. We shall, of course, still make efforts to compoy with our readers' main interests. The mailing list will be revised on the basis of questionnaires received and obsolete addresses will be removed. We need the co-operation of our readers in this respect. The distribution of copies will continue to be via surface mail only.

I trust that our readers will understand the need for the greatest economy at a time when resources are scarce and have to be utilized with utmost care.

K. Venkataraman
Special Technical Adviser
UNIDO Technology Programme

CONTENTS

NEWS AND EVENTS

Silicon foundry for ESCWA region

An ESCWA/UNIDO workshop on a regional silicon foundry and design centres was jointly organized with the Government of Algeria and held at Sidi Bel Abbes from 27 to 29 January 1986. The workshop agreed on the main conclusion contained in document UNIDO/IS.583 that the establishment of a regional silicon foundry cum design centres with a network of national centres should be pursued in an evolutionary manner. Recommendations were made for establishing design groups and the implementation of a multi-chip project; market studies for application-specific integrated circuits; a feasibility study for one or two pilot-plant-level silicon foundries in the region; and upgrading the two existing bipolar facilities to serve the purpose of regional co-operation. The Arab Fund for Economic and Social Development and the Arab Industrial Development Organization expressed concrete interest in financing certain follow-up activities such as the feasibility study for the pilot silicon foundry; market studies as well as a project for an Arab multi-chip. UNIDO will also support the national workshop organized by ESCWA on computer applications, from 26 to 29 March 1986 in Baghdad, Iraq.

Workshop on informatics in Argentina

A workshop on policies and technological and economic trends in informatics will be organized by the Argentinian Secretariat of Science and Technology in co-operation with UNIDO and the International Development Research Centre (IDRC), Canada. The workshop will be held at Buenos Aires from 28 April to 2 May 1986. The programme will include:

- Monitoring of economic and technological trends (custom and semi-custom chips, process control, numerical control, PAX);
- Informatics policies in selected countries (India, Republic of Korea, Sweden, Canada);
- Applications and impact of information technology.

Two documents have especially been prepared by UNIDO for this workshop, viz. Technological Trends in Selected Aspects of Microelectronic Technology and Applications: (1) Custom and Semi-custom Integrated Circuits and (2) NC-Machine Tools by J. Sigurdson of RPI, Lund.

UNIDO urges developing countries to be selective in setting up electronics industries

Third world hopes of joining the hi-tech revolution are a long way from fulfilment. A major obstacle to third world access is its lack of know-how and skilled manpower. Producing computer hardware, for instance, is manageable. But the third world is short on the accumulated knowledge and experience needed for software - the heart and soul of the computer.

A two-day conference in Yugoslavia in October 1985 on the future of developing countries in the field of electronics concluded that their achievements were scant and that huge problems remain.

But on the plus side, several countries, encouraged by the success of South Korea, Singapore, Hong Kong, etc., have plans to develop their own industries. India, which developed its first integrated circuit in 1971, is a third world leader in the field. Despite a new open door policy for electronic imports, industries in India are encouraged to set up their own research facilities. Requests for imports of technology are judged on the strength of in-house development.

While Bangladesh has not yet defined its electronics technology strategy, steps in that direction are being taken by a new committee of science and technology, and Dhaka University is planning an institute of silicon technology. Pakistan's Six-Year Plan (1983-1988) increased the priority for electronics, and the National Institute of Electronics, set up in 1980, is testing equipment and studying computer and microprocessor applications. A recent Pakistani study concluded that manpower would not be a problem if 1,000 engineers and electronic experts and up to 2,000 technicians working abroad contributed.

This may be over-optimistic. Other participants in the Ljubljana conference agreed that skilled manpower is an essential prerequisite for an electronics industry going beyond mere assembly operations. The lack of manpower of the required calibre has been a major snag to development of composite technology for integrated circuits in India. A constant brain drain is reported in Bangladesh, and in Venezuela and Mexico, engineering skills are used minimally in the hi-tech field, as engineers find jobs in management, sales and purchasing.

On computers, the problem is the software, and developing countries have to rely on US and Japanese computers and programmes. The software is thus out of their control.

To alleviate these problems, UNIDO recommended that third world countries select their electronics niches. In early stages of development, for instance, efforts might be geared to creating a supply sector, providing materials, components and sub-assemblies.

UNIDO also recommended joint ventures with foreign companies. But the problem with this is that it would merely provide, say, an Indian, Pakistani or Bangladeshi address for what are really Japanese, US or Western European companies. (South, December 1985)

Informatics in developing countries

During a seminar organised by the International Institute for the Development of Informatics at Bari, Italy, IBIPRESS (Informatics News Agency of the Intergovernmental Bureau of Informatics) interviewed leading government officials from developing countries as to the main applications of informatics in their respective countries.

In Peru the informatics application that has priority is in the public sector, an information system for the Republic's presidency processing information produced by the various Peruvian State bodies and enabling the President to take opportune decisions based on precise data of the country's general situation. The Peruvian Government has also established a National Informatics Commission.

In the Dominican Republic priority in informatics is centred on the development of data bases for the transfer and exchange of information and in the systems development area. In the farming sector, profitable experience has been gained with FAO's AGRIS and OAS' AGRINTEL systems.

El Salvador considers it important to keep an inventory of its human, natural and technological resources. The country has a large stock of under-utilized computers which should be organized to collect data on health, education, population, agriculture, etc.

In Ghana at the moment informatics is used mainly to support administration, i.e. accounting, payroll and banking. Other applications are in demography, teaching and research. Two projects started recently dealing with rural banking and computerization of customs and harbour administration.

Côte d'Ivoire spent US$110 million in 1985 on informatics, one third thereof in the public administration. Databases exist such as a socio-economic database, a financial database, etc. The number of informatics specialists may be estimated at around 3,000 people.

ECE seminar on industrial robotics

A seminar on 'Industrial Robotics '86 - International Experience, Developments and Applications', was held at Brno, CSSR from 24 to 28 February 1986 at the invitation of the Government of Czechoslovakia and under the auspices of the Working Party on Engineering Industries and Automation of the United Nations Economic Commission for Europe. The seminar was attended by 18 member countries of ECE as well as observers from Brazil, Korea, Iraq, Japan, Peru and Thailand.

The discussions dealt with (1) recent developments in robots and their components; (2) the economic and social impact of the use of robots; (3) government and other support programmes and international co-operation; (4) implementation experience in various application areas.

The seminar agreed on the following recommendations:

- ECE should undertake studies and/or organize seminars, symposia and study tours on topics related to robotics and computer-aided manufacturing in order to assess trends and permit the exchange of information;

- Efforts aimed at standardization undertaken by ECE should be directed towards achieving international consensus on effective guidelines for decision-making on compatibility of interfaces in elements of CAM systems, including robots;

- ECE and other international organizations should encourage and undertake activities aimed at strengthening international co-operation and the exchange of information on CAM, including robots.

First Pan-Pacific Computer Conference

The first Pan-Pacific Computer Conference (PPCC-1) was held in Melbourne from 10 to 13 September 1985, sponsored by IFIP and the Australian Computer Society. Over 1,000 attended. Two features of the conference were especially noteworthy: a "Schools' Congress", and a full day programme on computers assisting disabled people.

The Schools' Congress was addressed to school children aged 15 to 17 and their teachers. Its aim was to give a broad view of how computers are used in business and industry. It was attended by 600. Prior to the Congress, an essay competition was held for school children, on the subject 'Computer Technology, Society and the Future'. The winner was awarded a microcomputer, and her school received a computer system. (IFIP Newsletter, March 1986)

CAD/CAM/CAE conference in India

An 'International Conference on CAD/CAM/CAE for Industrial Progress' was sponsored by IFIP's Working Groups on Computer-Aided Design (WG5.2) and Discrete Manufacturing (WG5.3), and the Computer Society of India. It took place in Bangalore, India from 29 to 30 June 1985 and attracted 500 participants. The Conference was preceded by two tutorials, one related to Computer-Assisted Design (CAD) in mechanical engineering and the other related to Computer-Assisted Manufacturing (CAM). Some 250 people attended the tutorials. (IFIP Newsletter, March 1986)

Medical decision making by computer

A Working Conference on 'Medical Decision-Making: Diagnostic Strategies and Expert Systems' was held in Prague from 30 September to 4 October 1985, sponsored by the International Medical Informatics Association of IFIP (IMIA) and the Czechoslovak Medical Society.

The title of the conference reflects the fact that computer-assisted medical decision-making is arousing great interest. Developments in medical expert systems are rapid, and several research groups are placing major efforts in this area. Several reasons account for this growing interest: (1) the availability of special artificial intelligence (AI) languages and shells to build expert systems, (2) the fact that such systems are operational on rather small systems - even microcomputers, (3) the interest on the part of physicians and medical administrators in developing medical protocols and increasing the efficiency of medical care, and (4) the appearance of a new generation of researchers who are acquainted with computers and quantitative methods in medicine.

This was the second International Working Conference on Medical Decision-Making under the sponsorship of IMIA. The first conference comprised mainly statistical approaches to medical decision-making; whereas this conference clearly demonstrated the developments within AI in medicine.

It became clear from the results of this conference that the developments in the application of computerized decision methods and systems to medical problems has not yet come to an end. On the contrary; we have just begun to understand some of the basic principles of this very challenging new field, which concerns the core of medicine; diagnosis and therapy. And only with the assistance of different disciplines - medicine, computer science, mathematics and statistics, pattern recognition, and AI - can research projects be accomplished successfully. ... (IFIP Newsletter, March 1986)

British Computer Society: Colloquium on software sales and distribution

The Specialist Group on Software Protection of the British Computer Society presented a colloquium on 'Software Sales and Distribution: Method and Consequences', which was held at the Royal Institution in London on 27 February 1986. The seminar discussed methods of distribution of software and the problems encountered by software developers, dealers and users. The seminar was for the benefit of computer users and senior management of software as well as hardware companies involved in sales and marketing.

CAD meeting for small firms

The CAD/CAE specialist group of BCS designed a seminar on computer-aided design for the small businessman in December 1985. The seminar highlighted the benefits that CAD can bring to the smaller business because this technique can be used to increase competitiveness and profitability in today's harsh business climate.

Information on papers for the above two meetings may be obtained from the British Computer Society, 13 Mansfield Street, London W1M OBP, UK.

BOSTID: Microcomputer Applications for Education and Training

A "Symposium on Microcomputer Applications for Education and Training in Developing Countries" was held in Mexico from 4 to 7 November 1985. The symposium was co-sponsored by BOSTID and the National Academy of Engineering (AMIAC) of Mexico. Forty-three Mexican participants, under the chairmanship of Oscar Gonzalez Cuevas, president of AMIAC, met with 31 participants from outside Mexico, under the chairmanship of William Lawless, president of Cognitronics, Inc. In addition to the United States and Mexico participants came from Argentina, Brazil, Chile, Colombia, Kenya, Pakistan, Panama, Peru, Singapore, Trinidad and Tobago, and Uruguay.

The symposium was structured into three concurrent working groups on (1) training of teachers, (2) microcomputers and software for education at the preuniversity levels, and (3) microcomputers and software as aids to learning and investigation at the professional level. In each working group session, some presentations concerned policy or the philosophy of integrating microcomputers into the curriculum, whereas others were demonstrations of software or descriptions of projects actually under way in a particular country.

All three of the working groups agreed that information technology makes a useful contribution to the education process. Students should become able to use the computer as an extension of their capacity to think and to solve problems. The computer enhances educational productivity in teaching students to be creative, to think critically, to make valid decisions, and to explain and present their ideas.

The participants suggested that it is important for each country to take part in the development of microcomputers. Sharing of information across national borders provides guidance and permits co-operation among programmers and users with common interests. However, it is essential that these shared programmes be tailored to reflect local priorities.

A number of recommendations were addressed to government officials charged with setting policy. Training in the use of microcomputers should be offered to teachers, administrators, and the general public so that hardware and software selection can reflect community needs. Teachers, especially, must see information technology as a valuable resource, and teacher training institutions must make computer training an integral part of the curriculum. Continuing education in this technology should be provided for teachers already in the school system.

Finally, all the working groups emphasised the need for co-operative mechanisms to enhance communication at all levels. They suggested holding frequent conferences and publishing newsletters or magazines to diffuse microcomputer technology. It was strongly recommended that a standing committee be elected from among the participants at the symposium to investigate methods of improving international exchange. The committee was asked to explore the development of an international newsletter or journal and to initiate planning for an annual conference on microcomputer applications in education and training. (BOSTID Developments, Vol.6, No.1)

Workshop on Data Processing in ARI Studies

The BOSTID Research Grants Program recently hosted a workshop on "Microcomputer Applications to the Epidemiology of Acute Respiratory Infection (ARI)" held at the Asian Institute of Technology (AIT), from 6 to 17 January 1986. ARI projects are currently under way in Thailand, Nigeria, Bangladesh, Pakistan, India, the Philippines, Papua New Guinea, Kenya, Guatemala, Colombia, Brazil, Argentina, and Uruguay.

The workshop, held under the joint auspices of BOSTID, AIT, and the Mahidol University, was one of a series bringing together staff other than the principal investigator from each project. Previous meetings in the series included a workshop for virologists, held at the University of Michigan in April 1985, to devise common methodologies for viral diagnosis, and a meeting of the bacteriologists held at Johns Hopkins University the following month.

At the AIT meeting, grantees from all but one of the projects discussed common problems of data analysis. The ARI projects acquire their data from several sources: questionnaires that include demographic and socio-economic variables, health information on children, and records of weekly visits by medical personnel. Data from bacteriological and virological investigations must also be noted, as well as the results of physical examination, treatment of problems, and result of the treatment. ...

The opportunity to compare experiences and to learn together was particularly relevant and useful to the ARI participants, since the projects all share certain basic characteristics. Final analysis of the data should therefore yield results that will permit comparison of the epidemiology of acute respiratory infections in different countries and regions. (BOSTID Developments, Vol.6, No.1)

Commonwealth cuts aid for telecommunications

One of the few development agencies helping countries in the third world with their telecommunications is to lose one of its most important jobs. The Commonwealth Telecommunications Bureau is a partnership of 31 countries which liaises between the partners' telecommunications authorities. The Bureau's functions include financial accounting between partners. It transfers more than £3 million a year to pay for telecommunications between the members, and tips its billing according to the country's ability to pay.

From next month, however, the Bureau will lose this function. Authorities in the richer countries, such as Britain, want the members to pay commercial bills. The Bureau says this will cost the poorer countries more - but cannot say how much more. Britain, Australia and Canada provide three-quarters of the Bureau's budget. Over the past four years, they have steadily cut back support. The number of staff on the Bureau has dropped from 65 to 24. Officials there fear further cuts.

In February 1985, a commission appointed by the UN's International Telecommunications Union called for new efforts to aid telecommunications in the third world. Three quarters of the world's telephones are in nine countries, and Tokyo has more telephones than the whole continent of Africa. (This first appeared in New Scientist, London, 13 March 1986, the weekly review of science and technology.)

New international electronic network established

The network, called ECONET is intended to be used by development organizations world-wide and supposed to be cost-effective. ECONET provides direct dial-up access with a local telephone call in 600 cities in the US and in over 60 countries world-wide. ECONET is a data communications network which requires either a computer or a "dumb" terminal, a modem and a conventional telephone line. Also required is a telecommunications software programme. Monthly subscription rates as of end-1985 were $5-15; transmit surcharge $0.25.

ECONET is primarily for individuals or organizations working on issues related to community development, appropriate technology, disaster relief and environmental protection. For information contact: Farallones Institute, 15290 Coleman Valley Road, Occidental, Ca. 95465 USA.

University of Minnesota:

Microcomputers for improved plant protection

The University of Minnesota, USA, the Consortium for International Plant Protection/USAID Pest and Pesticide Management Project and the Food and Agriculture Organization (FAO) of the United Nations will sponsor an intensive training course on microcomputers for improved plant protection in developing countries. The course will be held at the premises of the University of Minnesota from 2 to 19 September 1986.

The training course will be organized into two modules: Module 1 will introduce the use of computers with extensive hands-on experience with common computer hardware and software operations. Module 2 will provide knowledge on the design and use of microcomputers for practical pest management. Participation is limited to 25 scientists from developing countries with minimal or no knowledge of the use of microcomputers in research or extension activities as well as plant scientists with some computer skills who would like to familiarize themselves with the latest microcomputer applications for pest management. The course cost is $3,500 including room and board. For information write to: Fred Haefer, Extension Specialist, International Programme Development, 405 Coffey Hall, University of Minnesota, St. Paul, MN 55108, USA.

Microcomputer acquisition and uses in development

The University of Minnesota also organizes a three-module training course on microcomputer acquisition and use (12 May to 6 June 1986; 14 July to 8 August 1986; and 6 October to 31 October 1986). The seminar is designed to guide individuals and organizations in planning, acquiring, implementing and managing a microcomputer system. It is especially oriented to microcomputer users in developing areas of the world. It is designed for senior and middle level individuals with administrative, management and planning responsibilities from developing countries. The cost is $4,000 per person including lodging. For information contact: Fred Haefer, 405 Coffey Hall, University of Minnesota, 1420 Eckles Ave., St. Paul, MN 55108, USA.

International Computer Training Programme

The George Mason University at the State University in North Virginia, USA organizes a computer training course to be held from 4 to 22 August 1986. The purpose is to familiarize university professors and graduate students in developing countries with the use of microcomputer technology in teaching and research. Specifically the programme is designed to provide competence in four areas:

- For faculty and graduate students with little or no experience with microcomputers, an introduction to state-of-the-art computing software and hardware appropriate for their needs;

- An understanding of the uses and potential benefits and costs that microcomputing can have in academic work;

- The development of basic skills in the use of selected software packages for word processing, data base management, electronic spreadsheets and communications;

- Sufficient practical knowledge and understanding to adapt software applications, maintain equipment, and help others comprehend the role of computing in their own institutions.

The programme is for university administrators and professors from developing countries and senior students currently studying in the USA who have little or no experience with computers, computer languages or computer science. The programme is open to applicants in the field of the humanities, the social and behavioural sciences, business administration, and the physical sciences. The registration fee for the programme is $2,700. Applicants may request support for registration fees and living costs (estimated at minimum $1,900 for three weeks) from USAID missions, the World Bank, the Inter-American Bank, the Asian Development Bank, or the UNDP. Applications should be sent, by 15 July at the latest, to International Computer Training Programme, Division of Continuing Education, Off-Campus Instruction, George Mason University, 4400 University Drive, Fairfax, VA 22030, USA.

CeBIT '86 at Hanover

The Hanover Fair CeBIT '86, which took place in March, offered a forum for 2,000 companies from 33 countries displaying the state of the art in information and communication technology. Fairs like CeBIT attract growing crowds because they are essential for gaining basic know-how, help businessmen assess the future and offer opportunities for contacts at all levels. The information industry is still remarkably vibrant. Computers, office automation, telecommunications and information products and services are still budding businesses. In 1985 global sales will exceed $450 billion with about $325 billion spent on telecommunications equipment and services. The remainder will be in computers, software and peripherals.

Some clear trends emerge:

- Because components used in telecommunication and data processing are virtually identical, one de facto industry exists. There are fewer computer and telecommunication companies and more and more firms that, like American Telephone and Telegraph (AT&T), are in the business of "information movement and management".

- The large corporate players come from different manufacturing backgrounds - telecommunications, office equipment or data processing - but they are now converging. Most will sell "integrated solutions" or "application-oriented systems" with an accompanying emphasis on training and service.

- Companies increasingly welcome industrial, technical and commercial co-operation and ventures which increase product lines, boost market penetration and provide access to technology and finance.

- Products will become more multifunctional, communicative and interconnected while value-added networks offer an ever-expanding number of services. The lifetime of many products will continually shorten because declining costs for components encourage speedier product growth and faster technical advances.

- Prices, marketing and expectations from both manufacturers and users will become more realistic.

- Many buyers of equipment, stuck with indigestible mixes of hardware and software, now seek an organization-wide, fully-integrated system from one primary vendor.

- Successful companies react quickly to changing market demand rather than attempt to dictate the market. ...

(Excerpted from a special report in Electronics Weekly, 7 April 1986)

US Conference on GaAs

A group of U.S. researchers and managers involved GaAs have joined forces to drive GaAs semiconductor processing out of the laboratory and into mainstream production.

The first step will be to sponsor a production-oriented conference. The embryonic industry's future depends on the establishment of a recognized community of manufacturing experts, says He Bong Kim, chairman of the board of directors for the first U.S. Conference on GaAs Manufacturing Technology. Kim says there are two goals for the conference, which will be held immediately following the IEEE Integrated Circuit Symposium in Greenlefe, Fla., in late October. One is to attract new talent, the other to discuss the industry's biggest stumbling blocks: materials growth, packaging, production yields, processing techniques, quality control, standards, and testing.

Without attacking these trouble spots, industry sources say, U.S. companies will lag behind Japanese chip makers, who many think are already more advanced in GaAs manufacturing techniques than their counterparts in the U.S. and Europe. Worldwide demand for GaAs is growing at a compound annual rate of almost 30 per cent, with demand for GaAs substrates expected to reach 16.9 million in.^{2} by 1988, according to market researcher VLSI Research Inc., San Jose, Calif. (see table 1, page 55).

Trying to garner as great a share of that as possible for the U.S., the conference's organizing committee decided to open the forum to U.S. citizens only. As the U.S. GaAs industry progresses along its learning curve, they say, it is essential that U.S. companies share their advances or face ruin at the hands of foreign competition.

Other conferences are not oriented toward pooling such expertise, say the organizers. "All the GaAs forums are research forums," says Kim, who has been involved with the technology since 1959 and is now executive vice president for GaAs operations at Ford Microelectronics Inc. in Colorado Springs.

The annual IEEE GaAs IC Symposium and other conferences consider manufacturing issues "mundane," he says, and as a result discourage research into these areas. "We don't have any recognition in the manufacturing technology area. So university students have this stigma in their minds that the only way they can achieve recognition is in the labs. I'd like to win maybe 10 per cent of these top brains into manufacturing technology. But how do we do it? We have to make sure their work is visible in their field."

Attracting top academic talent to the manufacturing fold is one of the GaAs conference's highest priorities, says treasurer Lester Eastman, an engineering professor at Cornell University. He is working at IBM Corp.'s Thomas J. Watson Research Center, Yorktown Heights, N.Y., while on sabbatical. "The most important reason for the conference is to attract bright young people to the technology - or it won't take off the way silicon did," he comments.

Industry participants agree. The conference's decision to link closely with universities goes beyond the desire to attract academic talent to the technology, says Allan Papz, president of Tri-Quint Semiconductor Inc., a Beaverton, Ore., GaAs company. "We want universities to have GaAs manufacturing as part of their curriculum." By rooting the study of GaAs manufacturing in the universities, Papz believes, U.S. GaAs companies will need to spend less time teaching their junior engineers the rudiments of the technology.

Besides the closed technical meetings, the conference will feature an open exhibition where GaAs manufacturers can show their wares - the only such exhibition in the U.S., Kim says. "This might not be the final answer for everything, but it's sure going to be better than what we've got." (Reprinted from Electronics Weekly, 17 March 1986, (c) 1986, McGraw Hill Inc. All rights reserved.)

Plea for last year's databooks

An interesting request has reached the Monitor from the Burma Broadcasting Service, Ministry of Information, Government of Burma which is now passed on to our readers:

There is a need for technical information in the third world; however third world organizations mostly do not have the hard cash to buy latest-edition databooks from companies in USA, Japan and Europe and moreover, they may not need the latest edition. For all practical purposes, an earlier edition (probably destined for shredding and re-cycling) would do just as well.

So, if companies, data analysts, government departments etc in developed countries would pick up the idea and make available "last year's" edition of such manuals, surveys etc. to users in the third world upon their request, the Microelectronics Monitor would be glad to arrange such donations.

In the words of Mr. Yin Sein from the Burma Broadcasting Service: "If high-tech is galloping, low/mid-tech (third world) is walking (if not crawling) and this information access is just one of the shots in the arm which is needed!

Selected calendar of meetings July-December 1986

8-10 July - Silicon Design Exhibition, Wembley. Tel. 01-242 3021, Project Presentations Ltd.

22-25 July - Artificial Intelligence Conference and Exhibition, Brighton. Tel. 01-584 4226, Conference Services.

21-23 August - Interaepcon/Semiconductor, Singapore. Tel. 01-891 5051, Cahners.

7-10 September - International Conference on Simulators, University of Warwick. Tel. 01-240 1871, IEE.

8-12 September - European Microwave Conference, Dublin. Tel. 0892 44027. Microwave Conferences and Exhibitions.

15-18 September - Euromicro 86 - Conference on Microprocessors and Microcomputers, Venice. Telex 44200, THES NL.

23-25 September - Semiconductor International, NEC, Birmingham. Tel. 01-891 5051, Cahners.

23-25 September - Electronics in Engineering Design, NEC, Birmingham. Tel. 01-891 5051, Cahners.

23-25 September - Design Engineering Show, NEC, Birmingham. Tel. 01-891 5051, Cahners.

23-25 September - ITAME 86 - International Test and Measurement Exhibition and Conference, Olympia. Tel. 0799 26699, Evan Steadman Services.

6-11 October - Interkama - Instruments and Automation Fair, Dusseldorf. Tel. 01-493 3893, Dusseldorf Trade Fair Agencies.

7-9 October - Internepcon Packaging Conference and Exhibition, Metropole Convention Centre and Brighton Centre, Brighton. Tel. 01-891 5051, Cahners.

7-9 October - Nineteenth Annual Connectors and Interconnection Technology Symposium, Anaheim. Tel. 0442 47948, Electronic Connector Study Group UK.

7-10 October - CAMP - Computer Graphics Show, Berlin. Te. 01-749 3061, Spectrum Communications.

7-12 October - Korea Electronics Show, Seoul. Tel. 01-439 0501, Korea Trade Centre.

15-23 October - Electronic Engineering Exhibition, Moscow. Tel. 0869 252131, British-CMEA Trading.

29-31 October - Electronic Displays 86, Kensington Exhibition Centre, London. Tel. 0280 815226, Networks Events.

29-31 October - Electronic Technology, Components, Instruments and Test Exhibition, Bombay. Tel. 01-940 6065, ITF.

4-6 November - Custom Electronics and Design Techniques Exhibition and Semi-Custom IC Conference, Heathrow Penta Hotel. Tel. 0799 26699, Slaughter, Steadman Assocs.

4-7 November - Internepcon, New Delhi. Tel. 01-891 5051, Cahners.

11-15 November - Electronica, Munich. Tel. 01-486 1951, Overseas Trade Exhibition Agencies.

18-20 November - Transducer/Tempcon Exhibition and Conference, Harrogate. Tel. 0822 4671, Trident International Exhibitions.

25-27 November - Controls and PC Systems, NEC, Birmingham. Tel. 0799 26699, Evan Steadman Services.

3-4 December - Communications Computer Show, Buenos Aires. Tel. 01-826 6107, Media Network.

(Excerpted from Electronics Weekly, January 1/8, 1986)

NEW TECHNOLOGICAL DEVELOPMENTS

Sixth generation: biotechnology linked with computing

Although a marriage between computing and biotechnology may seem far-fetched to us in the West, the Japanese are taking it seriously. They are preparing for an interdisciplinary sixth generation programme to embrace such research, and at least one Japanese computer company - Fujitsu - already has a biotechnology section in its R&D labs.

The Japanese have already been making rapid progress. Last year they announced plans to set up a sixth generation computer project to broaden the field of computer research to include psychology, psychiatry, and linguistics as well as biotechnology.

Eighteen months ago, Mideo Aiso, director of the Keio Institute of Information Science, and a key member of Japan's Institute for New Generation Computer Technology (ICCT), confirmed that the project would go ahead, within two to three years.

The project, which is expected to be low budget to start with, will be under the control of the Japanese Agency of Science and Technology. "The project will investigate the structure of the brain," said Aiso. "It will investigate inference mechanisms, including inductive inferences and imagination, and will embrace topics such as psychology and communications science. Although it will be very strongly pure science and most researchers will be from national laboratories, commercial companies are interested in taking part," he says.

Japanese mainframe manufacturer Fujitsu, for one, is already actively researching how biotechnology can be applied to computing in its biotechnology research section in its R&D labs at Numazu, in the shadow of Mount Fuji.

The reason for this biotechnology research is given in a matter-of-fact way by Kuniko Yoshii, assistant general manager at Fujitsu's Numazu plant. "We are concerned with everything that relates to computer systems and communications," he says. "Biotechnology relates to communications and that is why we set up an organization for biotechnology development activities." He stresses that we won't be seeing any results this century: "The biotechnology machine will be the product of the 21st century".

He adds that the biotechnology research is aimed at two directions - towards producing computer hardware of the future and for producing software which is capable of estimating or guessing without following logical paths.

Is this altogether too fanciful? Or should we be pushing forward the frontiers of our own interdisciplinary IT research programmes to take subjects like biotechnology on board? ... (Computer Weekly, 30 January 1986)

Silicon compiler speeds SLA designs

Suhas Patil excited a good many chip designers in 1979 when he invented the storage/logic array (SLA). One reason: this technology promised chip densities two or three times greater than either gate arrays or standard cells - even densities approaching those of full-custom, or handcrafted, design. But their enthusiasm quickly cooled when designers found out how difficult it was to design complex application-specific integrated circuits with this technology.

Little was written or done about storage/logic arrays and the design was rarely used. What people were waiting for was for someone to develop a computer-aided design system for SLAs that would make it easier to design ASICs. 1/ Patil to the rescue.

.....

1/ See also Microelectronics Monitor, No. 16, pp. 7/8.

The founder and vice-president of research and development at Cirrus Logic Inc. has coupled the SLA with a powerful double-level silicon compiler to design highly complex ASICs. Now the company is gearing up to produce 24-MHz hard-disk controllers and other custom microprocessor peripheral circuits at turnaround times of only three to six months. These designs promise the small chip size and high performance of handcrafted VLSI circuits that take a year or more to develop with conventional logic circuitry.

The primary difference between the SLA and a conventional gate array and standard cell is that the SLA uses both localized and distributed gates. The distributed gates perform both logic and interconnection functions. So, unlike gate arrays and standard cells, there is no need to set aside wide channels for SLA interconnections. This significantly improves density and gate-utilization efficiency. ...

Most semiconductor companies shied away from the technology because designing large SLAs becomes very difficult without a special CAD system. Cirrus Logic's answer to the problem - the two-level, interactive silicon-compiler - runs the software for the first level on a network of Apollo Computer Inc. colour-graphics work stations. Software for the second level runs on a Digital Equipment Corp. VAX-11/750 minicomputer that also compiles the SLA circuit elements. The two systems are linked in such a way that each designer can use the two interactively on the same Apollo work station. ...

After logic and timing are verified, the CAD system automatically compiles the array in the arrangement indicated by the detailed floor plan. The resulting circuit is correct by construction because the CAD system's layout software must follow the verified floor plan and because the design rules required to implement the actual array are contained in the CAD software. As the final step, the CAD system produces the tapes for generating the wafer-fabrication masks.

Designs can be modified at any time up to wafer fabrication. The floor-plan X-Y grid can be opened to insert more functions (symbols), or closed after functions have been deleted without affecting the integrity of other functions. Even major architectural changes, such as expanding a bus's width, can be accomplished within hours. Also, considerable modification is possible by changing the metalisation masks because the functions of many array elements depend on how the elements are wired.

Cirrus Logic's system now compiles designs based on three semiconductor technologies: 3-um n-MOS, 3-um CMOS, and 1.6-um CMOS with two metal layers. The next upgrade is expected to be 1-um CMOS with two metal layers. (Reprinted from Electronics Week, 20 January 1986 (c) 1986, McGraw Hill Inc., all rights reserved)

Superlattice device may be faster than GaAs

Measurements completed at Sandia National Laboratories in Albuquerque, N.M., suggest it may be possible to make strained-layer superlattice (SLS) semiconductor devices that will operate much faster and at lower power than those made from silicon or bulk GaAs.

Strained-layer superlattices, developed at Sandia beginning in 1980, consist of many very thin layers of compound materials such as GaAs, gallium phosphide (GaP), aluminium gallium arsenide (AlGaAs), and indium gallium arsenide (InGaAs). The layers are so thin that the atoms of one layer easily line up with the next layer, without causing defects such as threading dislocations. This permits fabrication of semiconductor materials with new electronic and optical properties.

The recent measurements showed for the first time the presence of light mass holes (lightweight, high speed positive charge carriers) in specially prepared samples of GaAs/InGaAs SLS material. Light holes are required in connection with light electrons if high speed, low power complementary logic devices are to be developed. ...

The lowest power bit storage scheme in general use - complementary logic - requires one transistor to be in the "on" state and one in the "off" state.

Conventional compound semiconductor materials, including GaAs, are being considered for many future computer applications. These contain high speed light electrons but do not contain light holes.

Because their mass is low, the electrons present in n-type GaAs and similar III-V semiconductors can move three to five times faster than they can through silicon. However, the corresponding holes in p-type material are relatively heavy, thus it is not possible to make low power high speed complementary circuits from them because of the extra mass.

The Sandia researchers recognized that the strain present in the SLS crystalline lattice, which changes the shape of a unit cell from cubic to tetragonal, would create an energy distribution that is favourable for light holes. The result would be to remove the degeneracy of the original valence band and to replace it with a split valence band that was energetically more favourable for light holes.

The research confirmed that the internal strain present in the SLS semiconductors alters the material's electronic band structure, allowing conduction by light holes. Holes in electronic devices made with conventional GaAs have a nominal mass of 0.5 on a scale in which 1.0 represents the mass of a free electron. In the light hole InGaAs/GaAs SLS material, the active holes typically have a mass from 0.12-0.17. The electrons have a mass of about 0.07 in GaAs and 0.26 in silicon. The effective mass of holes in silicon is 0.5. (Reprinted with permission from Semiconductor International Magazine, January 1986 (c) 1986 by Cahners Publishing Co., Des Plaines, Il. USA)

Prototyping gate-arrays in seven days

A gate-array logic device consists of a number of logic cells which are uncommitted to any specific purpose. The addition of a metallic layer (or layers) interconnects the cells and creates an integrated circuit specially made for a specific task. Circuits so produced are called semi-custom or application-specific I.Cs.

The advantages of semi-custom I.Cs are that they can reduce cost, are of smaller size, faster, use less power with design security and reliability. Their disadvantages are the costs incurred by the delays in the development phase; waiting for prototypes from a standard production line; the question of whether to breadboard the circuit; and the difficulties of obtaining small quantities of prototypes for evaluation and test modelling.

Most of the disadvantages stem from the fact that the semi-custom I.C. is manufactured on a production line which is devised for the large-scale production of standard I.Cs. These can be stored in large numbers and are available for prototyping whenever required. Semi-custom I.Cs need to be

produced in relatively small quantities of many different designs and are specially manufactured for a specific user. The methods described here can overcome the disadvantages and provide a quick turn-around for application-specific I.Cs.

A fully integrated facility is able to design, produce the metallic-layer pattern (in our example by E-beam lithography) and complete all tests before packaging the circuit. The system is intentionally designed for low-volume production with an upper limit of a few hundred I.Cs. Greater volume can be achieved by the conventional mass-production facility. With this in mind, the design produced can be transferred to a high-volume factory if required.

The design stage, in our example, is carried out on a Vax minicomputer. Three complete design packages are installed from Plessey, Ferranti and Mullard/Philips. The schematic layout can also be produced on an independent work-station and transferred to the Vax-based system. Most of the parameters needed in the creation of a new design can be set up and performed automatically, using computer-aided manufacturing techniques. The design package checks that the proposed device complies with certain rules of construction, rather like building regulations, and its electrical and capacitative performance are checked automatically. The software can simulate the device and also provide test patterns for testing the finished i.c. On completion, the design output is converted to a binary pattern of x-y co-ordinates (Cambridge binary format) to drive the E-beam. This is performed by specially developed software and is known as "pattern processing". E-beam lithography eliminates the need to produce a mask for the metallization process.

The Cambridge EBMF 6.5 is an E-beam device which is capable of "writing" on up to ten wafers in one run. Different designs can be written on different parts of the same wafer and it is even possible to mix wafers from different manufacturers which will have a different "floorplan".

A wafer is coated with an etch-resistant layer which will be sensitive to the electron beam when exposed. It is then positioned in the machine which must be aligned to recognise features on the wafer. No special alignment marks are provided, so the software must learn to recognise specific features. Once aligned the E-beam device sets up an x-y co-ordinate system across the wafer. Each die (which will end up as the integrated circuit) is individually exposed. If necessary, the machine can automatically compensate for any distortion inherent in the base wafer. Test patterns can also be made on the wafer to check the wafer quality and processing tolerances. (Electronics & Wireless World, March 1986)

Scaling down the cost of designing chips

Among electronics engineers, the next status symbol may be a personal chipmaking system. That might seem to fly in the face of reason, since making integrated circuits is becoming as capital-intensive as making steel. Still, a new technology called laser pantography promises to make the idea of personal chipmaking practical. That should help speed new products to market by giving engineers the ability to turn out prototypes of new ICs instantly.

The potential of using lasers to draw circuit lines on silicon has long been recognised in theory, and lasers are already used in some chip plants to fix circuit defects. The next step will be equipment for making the interconnections on so-called gate arrays - chips with generic, unfinished circuits. (Reprinted from the 10 February 1986 issue of Business Week, (c) 1986 by McGraw-Hill, Inc.

Researchers tilt silicon to grow pure GaAs on it

Researchers at the University of Illinois are cutting silicon ingots a new way - tilted at 4° and stepped in two directions atomic layer by atomic layer - so they can deposit extremely pure gallium arsenide thin films on a silicon wafer. They are also introducing layers of indium gallium arsenide atop the GaAs film to further lower defects at the surface. The results could lead to GaAs-on-silicon starting materials with fewer defects than available crystalline GaAs wafers.

The techniques, based on molecular-beam epitaxy, produce GaAs films on silicon that contain only 10^3 defects/cm^2. That compares with about 10^4 defects/cm^2 in standard liquid-encapsulated Czochralski-pulled crystalline GaAs wafers sold on the open market today, says Nadis Morkoc, professor of electrical engineering in the University of Illinois' Co-ordinated Science Laboratory and leader of the group that developed the new process.

The ability to grow GaAs effectively on a silicon wafer could have profound impact, sparking what one researcher describes as "an explosion of interest" in the field during the past couple of years. The list of companies pursuing the idea includes Fujitsu, Oki Electric, NEC, and NTT in Japan, as well as Texas Instruments in the US.

As a substrate replacement, GaAs on silicon could overcome handling problems associated with today's GaAs wafers, which are extremely brittle. Because the thermal conductivity of silicon is about three times that of GaAs, thin films of the material grown on a silicon substrate could also make possible the fabrication of more densely integrated and higher power GaAs devices.

Significantly lower cost could also be expected, because the GaAs thin films could be grown on much larger-diameter substrates than current 3-in. commercial GaAs wafers, says George W. Turner, a technical staff member at the Massachusetts Institute of Technology's Lincoln Laboratory in Lexington, Mass.

Turner, for one, says that GaAs-on-silicon wafers could be commercially available "within a couple of years". They will be used first as a straight replacement for crystalline GaAs wafers in building GaAs circuits, he believes. But the longer-term prospect is development of new kinds of devices that couple the optoelectronic and fast electronic switching properties of GaAs with the low cost and higher density of silicon by fabricating devices that work with each other in both the GaAs layer and the underlying silicon substrate.

Illinois researchers have successfully fabricated metal-semiconductor FETs and heterojunction bipolar transistors on their wafers. The devices work as well or better than comparable devices built on pure GaAs wafers, at frequencies from dc to about 20 GHz, says Morkoc. Lincoln Lab has reported similar results for some types of majority-carrier devices. At Texas Instruments Inc., GaAs-on-silicon bipolar and MES FET devices have achieved only 70 per cent of the performance of devices built in bulk GaAs, says George H. Heilmeier, TI vice-president and chief technical officer.

Most researchers agree, however, that the proof of the pudding will be the ability to fabricate a GaAs-based continuous-wave laser in a GaAs-on-silicon material that can work at room temperature.

minority-carrier devices such as lasers that rely on recombination to produce the optoelectronic effect are more severely affected by defects and dislocations in GaAs than are majority-carrier devices, says Lincoln Laboratory's Turner. The problem is that defects in the GaAs drive up the threshold current required for lasing, so far preventing fabrication of a cw laser in GaAs-on-silicon that won't burn up.

The Lincoln Laboratory group, as well as the Nagoya Institute of Technology in Nagoya, Japan, have reported the successful fabrication of pulsed GaAs lasers that work at room temperature in GaAs on silicon. (Reprinted from Electronics Week, 10 February 1986 (c) 1986, McGraw Hill Inc., all rights reserved)

Fibre-optics-could-hook-up-complex-chips

One tough problem in making integrated circuits is connecting circuit elements on the chips. Electrical connections are not ideal because currents can interfere with each other, and because the connection must be at an edge. The connections become a bottleneck that limits the chip's processing power. To get around the problem, engineers at Columbia University turned to optical fibres. Paul Prucnal, Eric Fossum, and Richard Osgood use a laser-assisted technique to etch holes into silicon integrated circuits. Before inserting the light-carrying core of a single-mode fibre into the hole, they dope the semiconductor at the base of the hole to form a simple p-n photodiode light sensor. The detector converts light delivered through the fibre into a current that serves as input to the chip.

The technique promises much higher density of connections, and thus faster transfer of information into and out of the chip. Electrical connections can be made only from the periphery of the circuit, but the fibre-optic connections can be made from top or bottom. Prucnal says each connection requires only about 100 square micrometres on the surface. Fibres offer other advantages: they transmit light signals faster than conductors carry electrons, they have a wider transmission band-width than electrical connectors, and they do not impose capacitive loads that could slow the circuit's operation.

An ultraviolet laser beam focused onto a wafer, submerged in water containing hydrofluoric acid, etches the holes. The laser stimulates an oxidation-reduction reaction between the semiconductor and the water (the hydrofluoric acid is not involved directly), etching a hole with a diameter depending on the size of the laser's spot. Typical holes are about 12 micrometres across, large enough to accommodate a single-mode fibre etched down to its core. As the hole is etched, it guides the laser beam, forming holes 200 to 300 micrometres deep with smooth and nearly vertical walls.

First experiments were with silicon, but Prucnal is also working on gallium arsenide. That material conducts electrons more quickly than silicon can, but a more important advantage is that light emitters can be made from gallium arsenide, but not from silicon. Prucnal want to make emitters at the bottoms of holes drilled in gallium-arsenide circuits, so chips can both transmit and receive optical signals. (This first appeared in New Scientist, London, 13 March 1986, the weekly review of science and technology).

IBM-chip-speeds-transmission-rates

IBM has developed an experimental chip to let processors take greater advantage of the transmission speeds possible with fibre optic cables. At a conference in Atlanta, Georgia, IBM engineers presented a paper on the chip which can handle data at 400 million bits per second (Mbps), a fourfold improvement on previous chips.

The chip would have significant relevance in speeding up transmission rates between central processors and their peripherals.

ICL claims to have been the first to incorporate fibre optic links for this purpose in its Series 39 mainframes. Its Macrolan connection transfers data at 50 Mbps.

The technology of fibre optics, however, allows for still faster transmission rates. In communications systems, where signals are normally multiplexed for distribution among several devices, data is readily transmitted at 565 Mbps. Field demonstrations can take this up to 2,400 Mbps.

IBM's chip receives electrical signals from a separate photo detector and amplifies them to logical signals suitable for standard computer logic chips. (Computer Weekly, 6 March 1986)

Memory-update-for-computers

A small Glasgow company is developing a novel form of memory chip. It could improve the performance of computers running programs to interpret data from sensors, such as sonar, radar and cameras. The chip, known as Generic Associative Memory (GAM), is the brainchild of Strathclyde University's computer science department, which is headed by Douglas McGregor. Strathclyde's initial research is now being developed by Deductive Systems, a two-year-old company that has close links with the university. The GAM chips are intended for use in computers that work on real time processing problems, for example machine vision, in which hardware is called upon to handle large amounts of data in a short space of time.

Conventional arrangements of a processor and associated memory are hamstrung by the fact that connections between chunks of memory within a memory chip and between the chip and its processor are fixed. On a computer that contains a large database of information in random access memory (RAM) this can be a major drawback, because data cannot be reorganised to suit a particular program. During one application a processor may be fishing data out of one section of memory, during another it may switch to another part of the store.

GAM memory chips contain arrays of memory that can be connected to one another along different paths. The connections are set up and broken by software contained in the computer system. A GAM chip is rather like a miniature telephone network with exchanges that set up and disconnect calls. A conventional memory chip is like a telephone network without exchanges in which every 'phone has to have a line to every other one. The ability of the GAM chip to set up paths within itself makes it possible to create a database in a chip in which cells containing associated information can be linked to one another, so speeding up the process of retrieving that information.

Deductive Systems' chip also contains logic circuits, which are capable of performing limited computations on data stored within it, again speeding up data handling. The switching ability of GAM chips is useful in military applications in which parts of a chip are more likely to be damaged by radiation or by being knocked about. Faulty areas of the chip can be bypassed by the switching system. The Ministry of Defence is interested in the research.

At present, Deductive Systems has built a prototype CAM chip in N-MOS, but with the help of £200,000 from the Alvey Directorate, plans to transfer its design to another chip technology called C-MOS. Chips built using the C-MOS technique are faster than those constructed in N-MOS. Strathclyde University is also involved in the project. The university has a grant of £229,000 from Alvey.

A second project sponsored by Alvey, called Admiral, also got under way last week. Admiral, which involves University College, London, British Telecom, GEC and Marconi involves work on the operation of high-speed data networks connecting large numbers of different computers and terminals. Researchers hope to produce software that will enable people to access such networks without using complicated codes and will guarantee to those that run them that only bona fide users are connected. (This first appeared in New Scientist, London, 23 January 1986, the weekly review of science and technology)

Getting a grip on pint-sized chips

Small packages come in good things. That's the attitude of manufacturers that are trying to cram more and more silicon chips into the innards of computers, instruments, and other electronic gear. So-called plastic chip carriers, which are bonded to the surface of printed circuit boards, are only a third the size of the traditional ceramic housings that resemble high-tech centipedes. But shrinking the package also shrinks the fragile metal leads that connect the chip to the outside world, making testing and handling more difficult.

Enter the Tape Pak, demonstrated last month at a trade show in Munich by National Semiconductor Corp. With it, chips are bonded on a copper tape, in the centre of what looks like a strange, squarish flower. Tiny copper leads radiate outward from the chip, blossoming into little "petals" that provide an outer ring of relatively large connection pads for testing. Once a chip has passed the test, the ring of petals is peeled off, leaving a surface-mount package so small that 10 chips can fit in the space occupied by a conventional package. As a result, electronic signals won't waste as much time travelling from chip to chip, so performance of finished systems will improve. (Reprinted from the 16 December 1986 issue of Business Week, (c) 1985 by McGraw-Hill, Inc.)

Making a "crashless" supercomputer

Tomorrow's supercomputers will consist of several processing units, perhaps even thousands. Almost everyone agrees on that. But there is little agreement on how to prevent these systems from "crashing" when two or more processors battle to use the same section of memory at the same time. A small band of computerniks at Sullivan Computer Corp. are rushing to put the finishing touches on a new supercomputer, slated for unveiling in about 12 months, that is engineered to avoid such internal conflicts.

The new supercomputer will leapfrog the fastest machine now available by at least 10 times, claims President Herbert Sullivan. In some applications it could be 100 times faster. The key is a unique memory "architecture" developed at Columbia University and Chopp Computer Corp. It is totally random. Data are not stored in specified memory locations. Instead, they get slapped into the first available spot the computer finds, along with a tag that describes the contents. So, if there is a traffic jam in one part of the memory, the computer simply skips to someplace else. The fundamentals of this approach are also being incorporated into the Ultracomputer that New York University is now building. (Reprinted from the 9 December 1985 issue of Business Week, (c) 1985 by McGraw-Hill, Inc.)

MARKET TRENDS

Reversed trend in chip development

A total reversal in the trend of chip development of the last 20 years is upon us, according to Dr. Jack Kilby, the co-inventor of the integrated circuit. The cycle of shrinking geometries leading to both higher performances and lower costs may be about to break, he said in a lecture delivered at the Fiarex 86 trade show in Amsterdam. A two-tier chip market may develop as squeezing more elements onto devices starts to push up manufacturing costs, he said.

"We will see families of low-cost circuits that will be less dense than high performance circuits. The lowest cost circuits may not be the most complex circuits and they will almost certainly not be the highest performance circuits," he said. "Up to now, we've had almost a free ride as photolithographic techniques have improved. Each improvement in geometry led to lower costs. I think that in the future this will be less true." Kilby continued. "This trend has continued for so long that it is frequently taken for granted. It is at least possible that future shrinks will only be attained at an increased cost per function," he said.

Dr. Kilby said that he did not know when this would begin to happen. "At some point we will reach that level. It is not obvious to me why a 4Mbit memory should cost less per bit than a 1Mbit memory," he said. And although it may be cheaper, what about 8 or 16Mbit devices? Indeed, he speculated that it may already have started to happen and that it is being concealed by the experience-curve pricing policy of the semiconductor industry. "Complexity of chips has doubled every year. About half of this improvement is due to cleverness; better ways of laying out devices and simplifications of design. The other half of the improvement is due to shrinking geometries. It is not clear to me that there are any bounds to cleverness and so this may continue indefinitely. It is not quite so clear to me that geometrical factors will continue indefinitely," he said.

Kilby added that physical limits were beginning to become apparent in device geometries and although these limits had not yet been reached it was clear that they existed. Getting higher performances means getting ever closer to those physical limits and that would cost more.

The only way around these physical limits would be to use some completely new and as yet unknown technology, said Kilby. However, he also pointed out that the only reason for wanting to put more elements onto the same device is because it is more efficient than having them on several devices which have to talk to each other. "There really isn't any difference between the number of connections needed between four 1Mbit chips and those on one 4Mbit chip. If there were a real breakthrough in interconnection technology then this would take the pressure off complexity," he said. (Electronics Weekly, 19 March 1986)

Dataquest goes optera

The recovery in the semiconductor industry is under way, and has been since the fourth quarter of last year, according to market analyst, Dataquest.

Speaking at the opening of the Semicon show in Zurich, the director for European operations at Dataquest, Malcolm Penn, said that production capacity has converged with demand, the book-to-bill ratio continues to improve, lead times are starting to edge out, and prices have started to recover from their depressed 1985 levels. January saw the book-to-bill ratio in the US and Europe both break the 1.0 barrier.

"We believe this recovery will accelerate in the second half of 1986 and on into 1987. Overall we are presently projecting around 15.7 per cent growth worldwide in 1986, with European consumption growing 6.3 per cent," he said.

"The pessimists argue on three counts. First that there is far too much installed excess capacity even if demand does turn up. True. Capacity utilisation is still low, but it is up from two quarters ago. In addition, it takes a finite time to ramp up this capacity - several weeks at least to turn it into billable shipments. Furthermore, capacity at the leading edge (sub two-micron) is not that much in excess. This is where the major upturn in demand is likely to occur.

"Secondly, that demand from the big OEMs has not really improved. The present upturn is distributor-driven, building inventories back up. Without OEM follow-through, that could evaporate overnight. True again, but distribution always leads the market recovery. Furthermore, the exceedingly high level of 'turns' business at the distribution level is masking the improving OEM demand.

"The fact that pricing and demand have turned up so strongly without a positive OEM push means things should more likely get better rather than worse.

"Thirdly, where is the hot product out there to drive unit orders, like the PC did in 1982-1983? Well, prior upturns also lacked a demand driver. In this regard, the 1982-83 PC phenomena was unique, and with hindsight, not particularly healthy. It is more usually a combination of several new product areas plus better demand from traditional markets that drive the recovery process.

"In summary component pricing is going up, specially in the MOS memory and microprocessor areas. Partly this is as a result of political and trade pressure on the Japanese suppliers. They really have three choices here - do nothing and risk protectionist legislation, allow more access to Japanese markets, or allow prices to rise. Quite frankly the latter is the easiest (and profitable) for them to adopt," he added. (Electronics Weekly, 12 March 1986)

SIA forecasts 18 per cent total growth in 1986

The semiconductor industry will grow overall by 18 per cent in 1986, after declining a like amount in 1985, according to figures presented by the Semiconductor Industry Association (SIA) recently.

Dr. Gilbert F. Amelio, speaking at the SIA annual forecast dinner, said digital CMOS will lead the way in growth in 1986 and was, in fact, the only major product category whose sales increased last year. Amelio, president of Rockwell International's Semiconductor Products Div., reported several factors driving the demand in CMOS. Among them: a strong telecom market, military spending, replacement of NMOS and rapid growth of application specific ICs (ASICs).

While the digital CMOS market grew only 7 per cent last year, SIA's forecast for 1986 calls for a growth rate of 30 per cent. "In the next three years," Amelio noted, "CMOS RAMs will grow more than 60 per cent a year."

After last year's overall decline of about 17 per cent, total worldwide semiconductor sales are predicted to recover in 1986 "to almost the same level as 1984," Amelio added. He said the turnaround should begin the last quarter of 1985, with worldwide sales increasing by 3 per cent over the third quarter to $5.3 billion.

Long-term growth (1983-88) is forecast to be 16 per cent annually, with sales in 1988 reaching $38 billion. This will represent a 78 per cent increase over the next three years, Amelio said.

By product categories, he reported, worldwide sales of discretes will recover next year to $5.3 billion, close to 1984 levels, while the long-term growth rate for discretes (1983-88) is expected to amount to 8 per cent. Within that product category, opto is the fastest growing segment.

Analog ICs will also resume their growth next year, with a "normal" increase of 11 per cent, he said. Over the next three years, data conversion and interface analog will post the highest growth rates, he reported. Long-term compound growth rate for analog (1983-88) is projected to be 15 per cent annually.

Bipolar digital ICs, heavily used in mainframe computers, are expected to rebound. "Mainframe shipments have been flat in 1985, but we expect them to advance crisply in 1986," he said. Long-term growth for this category is estimated at 16 per cent per year.

NMOS/PMOS logic will show a long-term growth rate (1983-88) of 14 per cent annually, Amelio said. Although CMOS will continue to displace NMOS as a percent of the total over the next three years, NMOS will still grow in dollars, he reported.

NMOS memory, which includes PMOS, DRAMs, SRAMs, ROMs, and E-/EEPROMs have book-to-bill ratios "which have yet to show recovery," Amelio remarked, adding, "In the category of memory, the outlooks of the various forecast participants showed the greatest divergence of opinions." The long-term growth rate, he said, is expected to be 13 per cent annually, with an average growth over the next three years of 25 per cent, led by RAMs at 38 per cent.

Looking at the major markets, Amelio said the US market, while still the largest, "is by far the most volatile, down 29 per cent this year, but up 25 per cent in 1986. The forecasters believe this volatility is due to the inventory problem and to flatness in mainframes and personal computers this year".

He said since the 1985 recession has been less severe in Europe, "the rebound will be less dramatic". The Japanese market will have the largest increase from 1984 to 1986. It increased from 31 per cent in 1983 to 35 per cent in 1985, and will stay at that level through 1988, he said. In three of the six major product categories forecast (discretes, analog and CMOS), Japan is now the largest consuming segment. The "Other international market", (Pacific Basin) is about $1.5 billion in size. That market, which also declined this year, is expected to climb again in 1986, he said.

In answer to his own question, "What went wrong this year?" Amelio cites these factors: OEMs experienced a slow-down in growth, particularly the computer industry, which consumes 40 per cent of the industry's output. Additionally, he added, "before this trend was understood, huge semiconductor inventories were accumulating in the stock bins ... of our OEM customers, and by the start of 1985, $2-2.5 billion of excess components were in customer inventories."

Amelio told the audience, "Don't be misled; 1985 was more than an inventory correction. End user consumption is down." He said users want more innovation that will give them better reliability, higher performance and lower prices. (Semiconductor International, January 1986) (Reprinted with permission from Semiconductor International Magazine, Copyright 1986 by Cahners Publishing Co., Des Plaines, IL, USA)

Overview of semiconductor industry

The coming year, 1986, promises to be a year of significant change. We are beginning with a severe economic recession across a broad front of semiconductor markets, economically coupled with a depression in the pricing of semiconductor high-density memory devices. This period of economic stress has been driven by recently collapsed unrealistic expectations of expansion in the computer industry, especially for personal desk-top computers of all sizes.

In 1983 and 1984, the semiconductor industry, in response to anticipated increased demands for computers, installed unprecedented new production capacity for very large scale integrated (VLSI) circuits. Much of this capacity is also capable of large wafer diameter production. Therefore, semiconductor manufacturers have suffered recently from the double effects of reduced demand from the largest segment of its customer base (computers) and a significant overcapacity to produce integrated circuits.

I believe that new products are required in order to make 1986 and 1987 strong, positive years for the semiconductor industry. Each of the major semiconductor manufacturers have selected their strategies and product thrusts for the rest of this decade. Significant structural technological-based shifts are occurring, such as the emerging dominance of CMOS high-performance devices designed to earn a higher average sales price or the increasing use of device customization as seen in the growth of application specific integrated circuits (ASICs).

With the overwhelming price pressure that exists for any device that is produced in significant volume, clearly product cost control as well as enhanced performance will be mandatory. Semiconductor manufacturers unable to implement low-cost processing of VLSI circuits will not be able to compete in the world semiconductor markets.

Circuit density changes

A trend that should accelerate in 1986 is the increasing frequency of changes in circuit density. With more complex products taking longer to design and yet having a shorter life cycle before economic obsolescence by yet higher density circuits, the timing of production technology becomes even more critical. The emergence of volume 1M DRAM (dynamic random access memory) manufacturing is a vivid reminder that earlier design of advanced circuits will be necessary for a semiconductor manufacturer to maintain leadership products. Indeed, companies emphasizing a single product family (such as DRAMs, EPROMs, etc.) will probably live or die by the timing of production availability of each new generation of product. Computer aided design and engineering tools provide quicker design iteration with a higher percentage of "first silicon" of a new part actually functioning.

Recently, "fast masks" are emerging with mask makers receiving CAD-generated tapes of a design in an afternoon and with delivery of finished reticles the following day. In addition, "fast fix" masks are quickly available by selective repair of the design by ion beam repair.

These efforts are designed to achieve first functional silicon and initial device characterization, correction and prototype within days rather than months.

In theory, we knew these capabilities would come. What has changed (under the stress of economic change) is implementation - now!

Therefore, tomorrow's leaders must be able to integrate CAD design, fast masks, fast fix, fast functional first silicon, and prototype proof with cost-controlled production follow-through to maintain leadership and profit.

More electronic function

Another major trend is to achieve more electronic function on a given area of silicon. For example, we have already been given tastes of 32-bit single-chip microcomputers, 1M DRAMs and "smart chips" that integrate CPU logic, memory, power and necessary input-output devices. And already we hear of the printed-circuit board on a chip - the so-called silicon PCB - including on-chip testing to significantly reduce the net electronic function cost.

It is exciting to see that the necessary technologies and tools required to achieve such system integration are moving rapidly toward practicality. Such capability leads us toward ease of integrated telecommunications (voice, video and data), parallel processor computing, and true speech-oriented, user friendly interfaces. These three applications each can provide explosive growth in applications and, therefore, growth for our industries.

It is also clear that "systems on a chip", or "super chips", and "printed circuit boards and chip" all are most easily accomplished by systems-oriented semiconductor companies and divisions of systems companies. For survival in the future, merchant semiconductor companies must either become system-oriented organizations or create strategic partnerships with systems companies.

In the midst of the economic hardship now being experienced by semiconductor manufacturers, and semiconductor equipment and material suppliers who support the semiconductor industry, I see a clear vision of hope with more effective electronic functions moving to the market place. Economic break-even points are being lowered; inventory is adjusting to underlying demand; and the structural pieces on which the future must be built are coming together.

Our industry is driven by the ability to deliver more value to the user of electronic devices. Another "step function" in that delivered value can be achieved with the technologies that are now falling into place. The economic stress of 1985, and with which we begin 1986, is accelerating the implementation of these factors. Those

companies successfully managing this period of accelerating change should see expanded growth for the next decade. (Semiconductor International, January 1986 by Samuel A. Harrell, Ph.D., President, Semiconductor Equipment and Materials Institute (SEMI), Santa Clara, Calif., and President, Micronix Corp., Los Gatos, Calif. Reprinted with permission from Semiconductor International Magazine (c) 1985 by Cahners Publishing Co., Des Plaines, Il. USA)

Top-10 Semiconductor Sales

Ranking 1984	Ranking 1985		Sales $bn*
2	1	NEC	1,950
1	2	Tex Inst	1,815
4	3	Hitachi	1,750
3	4	Motorola	1,650
5	5	Toshiba	1,370
8	6	Fujitsu	950
7	7	Intel	900
6	8	National	890
10	9	Matsushita	870
9	10	Philips**	850

* Forecast for 1985
** Includedes Signetics

Source: Integrated Circuit Engineering

Memory chip fever rises

About 20 US and Japanese companies are beginning to sell the first chips with megabit memories. Among them, Texas Instruments, Toshiba and Nippon Electric seem to be doing best. The latter two, in fact, have issued statements in which they say they will be ready to deliver the legendary 4-megabit dynamic random access memories (D-RAM) by the end of the year. The scramble for the new place of honour on the market of the new generation of chips with storage capacity of several megabits therefore seems imminent.

In recent years the American firms of this sector have been going through particularly difficult times because of the merciless competition of the Japanese firms and of the slump in world demand for this product. The consequence has been that the price has fallen to minimum levels. The sales of semiconductors in 1985, in fact, according to the Financial Times, had fallen to US$1.2 billion from US$3.5 billion in 1984. The price of the 256K D RAMS at the middle of last year had fallen 80 per cent compared with the same time the previous year. For these reasons, many companies, such as Intel, National Semiconductor, Motorola etc., had abandoned the field; others curtailed their involvement in the sector.

The air now seems to be changing. Prices seem to be going up due to the shortage of supply created by the exit of numerous companies and to the increasing demand for ever more powerful chips suited to the sophisticated computers of future generations. Expectations for the end of the decade are for a world D RAM market that will touch US$6 billion - while it ought to reach US$2 billion already this year. Moreover, this is a great opportunity for the Japanese industries to re-enter the international market en masse. The manufacture of 4 or even 16 megabit chips would give them the chance of getting around the obstacle to exports into the USA, constituted by the anti-dumping duties imposed by the US Government on the present family of chips made in Japan.

The technology developed with the D-RAMS opens new prospects as well for the manufacture of devices with a great many potential applications.

It will be possible to apply chips whose storage capacities may be measured in megabits, for example, in future digital television where it will be possible for us to show more than one channel simultaneously. Not only mainframe computers but also PCs will be able to handle more and more sophisticated functions. It will be possible to install special, particularly fast D-RAMS in computers for scientific uses or for engineering plans.

The chips developed for these new application areas which are the first to reach the market will, according to experts, enjoy a particularly favourable situation which will, of course, be reflected in the price. It is with this in mind that the large industries in the sector are moving with so much celerity. (IBIPRESS Bulletin No. 73, 23 March 1986)

Conquest of one-megabit D-RAM memories

Technically speaking, it may already be said that the generalized launching of new one-megabit (million-bit) D RAM (dynamic random-access memory) memories is the beginning of the obsolescence of the 256Kbit (1Kbit equals 1,024 bits) D RAM memories. Thus there is reason to suppose that the 256Kbit (K) generation will have a shorter life than its predecessors. Its sales are continuing to increase, given its low price (approx. US$2) it is favoured over the 50 to 100 US$ the one-megabit (m) memories cost. It is hoped that the sales of 256K memories will go from the 200 million units in 1985 to 500 million units in 1986 and that they will crowd out the production of 64K memories. As far as the 1 m memories are concerned, the drop in their price to a competitive US$10 will take a while. Dataquest predicts that sales in 1986 alone will amount to US$260 million in 1990. On the other hand, it is supposed that sales will reach 1,400 million units with a value of US$3,500 million. (IBIPRESS Bulletin No. 70, 2 March 1986)

Europe joins the race for superchips

Politicians wrangle over Europe's future in microelectronics, while researchers in Holland and West Germany master the industry's building blocks. Philips in the Netherlands and Siemens in Germany are spending £400 million to learn how to work with components less than 1 micrometre across. The aim is to catch up with Japanese companies in building very powerful microprocessors. The researchers say they will have a dynamic random-access memory capable of handling four million bits of information by 1987.

The venture, called the Megaproject, is developing optical equipment accurate enough to imprint details as small as 0.7 micrometres across on silicon chips. Fine structures mean faster components, which are essential to very large-scale integration. The goal is to cut the switching delay of transistors to 90 picoseconds. Until now, such speeds have remained in the domain of bipolar transistors, which can handle only tiny currents.

To develop the technology for working at these sizes, Philips is working with an optical system operating at the emission line of mercury light (356 nanometres). The lens is incorporated in a wafer stepper, which reproduces patterns of integrated circuits to be reproduced repeatedly on a wafer of silicon.

The idea is to project the reduced image of a mask (the glass plate that carries the original image of the circuit) through the lens onto part of a silicon wafer. A photosensitive chemical covers the surface of the wafer. Following processing, another layer of photoresist "fixes" the circuit's pattern.

The wafer then shifts away, and projects the pattern again. When the wafer is covered with these identical patterns, it is cut up into separate chips.

Lithography with X-rays can define structures smaller than a micrometre. This process requires very precise positioning: the mask and chip must be in the right position to within a few hundredths of a micrometre. The only way is with a piezoelectric drive - crystals of quartz that move by minute amounts in response to a voltage across them.

The researchers are still struggling to overcome obstacles in the race for smaller and more complex chips. One is the difficulty of isolating transistors from one another. The 1-micrometre structures on a 1-megabit memory conduct 5 volts, which is enough to generate a powerful electrical field between separate transistors. The phenomenon can endanger a circuit's stability. The way round is to apply a thin layer of metal over the wafer's surface.

Static memories with capacities of 1 megabit contain more than five million transistors. Only a computer can design and test them. Siemens has developed a computer-aided design system called Venus. It stores a library of standard cells which act as building blocks for a circuit. It translates the logic diagram into a layout for a circuit which serves as the basic model for developing the required chip. The technology cuts the time taken to design an integrated circuit containing more than 5000 logic gates from months to a few weeks. ... (This first appeared in New Scientist, London, 20 March 1986 weekly review of science and technology.)

Europe leads the CAD market

In a recent conference held in Detroit on software for computer-aided design (CAD), the fact was highlighted that Europe has had considerable success with solids-modelling systems. European producers of CAD software, in fact, have available a number of solids-modelling products unequalled by American competitors. An example of how things are going is given by Matra Datavision, an American subsidiary of the French Matra S.A., which has announced an increase in CAD software sales by the end of 1985 of 100 over the previous year. That figure is expected to reach 130 by the end of 1986. A number of American firms, moreover, have begun sales and others have introduced CAD software solids-modelling possibilities into their wire-frame systems.

The reason for so much success must be seen in the difference in representation methodology of what is to be displayed and eventually analysed and modified, as adopted by the Europeans as opposed to their American counterparts. The latter utilise the wire-frame method, by means of which a solid is designed by connecting points and lines. Figures represented in this way are shown in a certain perspective, but cannot have solid outside walls.

In European products, not only is it possible to represent any solid in full-wall form, but it is also possible to measure the area and volume of the solid represented, which is extremely important in cases when the part represented, once fabricated, must be painted.

Further advantages of European over American products is the capacity to store all the images created in a central database, as well as the capacity directly to control programmable parts production equipment.

At a time when all machinery producers are centralising the control of automation of their production chains, European CAD products seem suitable to satisfy market needs with swiftness and quality. (ISI Press Bulletin, 17 March 1986)

US/Japan IC pact

The possibility of a worldwide agreement by the US and Japan to monitor the prices and production costs of semiconductors has sparked adverse reaction from the EEC. Already concerned by a trade deficit in semiconductors in many EEC countries, the Commission is asking for further details on the pact.

These moves follow last week's ruling by the US Commerce Department that Japanese companies dumped EPROM devices on the US market. The action brings severe import duties to eight Japanese firms, and almost eliminates their ability to compete on price inside the US.

The Commerce Department handed down its preliminary 'dumping' finding, responding to a joint complaint by AMD, Intel and National Semiconductor. The management research firm, Dataquest, expects this action will push up worldwide prices of EPROMs.

While the US industry, and American branches of the affected Japanese firms, expected the Department to agree with the complainants, the anti-dumping duties surprised them all. The duties vary from 22 per cent for Toshiba to 188 per cent for NEC.

Dumping, under US laws, is defined as foreign companies selling below "fair market price", which is full loaded production costs plus an eight per cent profit.

The importers found guilty of dumping must post cash deposits or bonds equal to the extra duties. This is a preliminary finding and may be overturned. But the deposits go into effect immediately.

The Japanese importers are free to pass along the increases in cost to customers, or keep their prices the same and absorb the difference. The dumping laws also have unknown problems for US companies. For example, Texas Instruments produces much of its memory chips in Japan and could be subject to dumping regulations while its US producing competitors are not.

Dumping is not applied to domestic producers. According to sources at AMD, TI had been asked to participate in this dumping, but declined. (Electronics Weekly, 19 March 1986)

Semicustom/Custom Market:

Field-programmable logic: a new market force

Field-programmable logic devices are showing strong signs of becoming a major force in application-specific integrated circuits. Up until just recently, they were not regarded as a threat by the vendors of gate arrays and standard cells, even though they were smaller and simpler to use than gate arrays, had a faster production turnaround time, and could be programmed by the user. The problem was that FPLDs were neither as dense nor as fast as the competition. They ran no larger than 100 to 300 gates, compared to 1,000 to 6,000 for gate arrays, and at 50 to 75 ns weren't all that fast compared with the tens-of-nanoseconds speeds of gate arrays.

Now gains in density and speed are putting FPLDs on a par with gate arrays in performance. And thanks to computer-aided design tools, they have remained easy to use, with a turnaround time of 1 to 6 weeks where gate arrays require 6 to 18 months.

By 1984, sales of field-programmable logic had grown from a minuscule share of the $5.5 billion ASIC market to $230 million. By 1990, they will more than quadruple, to $1.02 billion of a $13.7 billion

market, according to Dataquest Inc., San Jose, Calif. Other companies in the market are even more optimistic. Robert Hartmann, vice president of engineering at Altera Corp., Santa Clara, Calif., predicts that field-programmable logic will account for $2.12 billion in sales in 1990. He also expects that $300 million of that will come out of the gate-array market, leaving gate arrays with a $2.4 billion share (Fig. 1) on page 55.

Another sure sign that field-programmable logic is maturing as a semicustom alternative is the rapid increase in the number of companies coming out with products. From a market with essentially two players - Monolithic Memories Inc. and Signetics Corp., which were the first to develop programmable-logic chips - it has grown to include such major semiconductor manufacturers as Advanced Micro Devices, Fairchild Semiconductor, GE/Intersil, Harris Semiconductor, Intel, and National Semiconductor, as well as such startups as Altera, Lattice Semiconductor, VLSI Technology, and Xilinx. Other indicators that the technology is coming into its own are new process alternatives, the proliferation of new logic architectures and programming techniques, and the development of CAD tools as field-programmable logic becomes denser and more complex.

One of the more obvious changes in the programmable-logic market has been a shift from bipolar to CMOS and from fusible-link to floating-gate-based ultraviolet and electrically erasable logic arrays (EPLDs and EEPLDs). Although about 90 per cent of the field-programmable logic devices sold are of the bipolar fusible-link variety, CMOS EPLDs and EEPLDs are growing more popular. Even traditional bipolar suppliers such as Monolithic Memories and AMD are planning to introduce CMOS versions sometime this year. ... (Reprinted from Electronics Week, 27 January 1986 (c) 1986, McGraw Hill Inc., all rights reserved)

Custom-CMOS

Although the consumption of CMOS semiconductors dropped sharply last year, the number of designs being implemented in the technology will continue to grow (see below). In particular, the opportunities offered by small-scale prototyping facilities look good.

The reasons for using CMOS are:

(1) A CMOS gate dissipates power only during the transition from one state to the other, and has negligible power dissipation during standby conditions. Therefore, for a given package, power dissipation and average gate delay, the maximum number of gates that can be integrated on a chip is orders of magnitude larger for CMOS circuits than for either bipolar or NMOS circuits of any other technology.

(2) Propagation delay for a CMOS gate is only slightly longer than for an NMOS gate. For a two-micron gate length, sub-nanosecond gate delays are possible.

(3) The CMOS inverter has a high degree of built-in noise immunity, since the output voltage swings completely from one supply voltage to another.

(4) CMOS circuits are easy to design in comparison with other circuit forms.

The advantages offered by prototype production of custom CMOS ICs include a fast turnaround time (10 to 15 working days). This has to be offset against low productivity of labour and extremely low productivity of capital equipment, even though equipment costs are minimised.

In considering a small-size facility though, where the initial investment in processing equipment is kept to a minimum, it has to be remembered that the skill and intelligence of the technical staff is more important than their wafer fabrication productivity.

These high manufacturing costs can be justified by the fast turnaround time achieved - two weeks instead of the six to 12 weeks normally obtained on a semiconductor manufacturing line. Many engineering managers believe that once a team is assigned to a project, money is expended at a more or less constant rate until the project is completed.

The division of labour and level of experience required for staff in an organization of this nature is different. For example, operators in the wafer fab area are cross-trained to work on several pieces of equipment. This allows them to carry by hand a batch of wafers through several sequential process steps, eliminating an inventory delay.

With only one wafer stepper used on two full shifts, our pilot line production would be limited to 500 wafers out per period (one period equals four weeks). For such output, all other equipment is used a maximum of 60 per cent of the time it is available. This allows plenty of time for maintenance and enhances turnaround time.

To reduce even further the load on heavily used equipment (wafer stepper, ion implanter, oxide etcher, and one furnace), the equipment might be duplicated. Additional space is provided for that purpose in the layout and design of the facility.

For photolithography, our prototyping line would use one 5:1 wafer stepper for all the masking levels requiring high resolution and/or the smallest registration error to the previous pattern, and a 1:1 scanning projection system for all remaining layers. For a CMOS circuit with double layer metal, the critical masking levels are the same as for an NMOS circuit.

Clearly, a systems house has a strong motivation to set up an IC fabrication facility as a means of implementing proprietary designs into silicon rapidly and with complete control of the process. Alternatively, this function can be carried out by small, efficient companies dedicated to the production of custom ICs. (Electronics Weekly, 19 March 1986) (See table 2, page 55.)

Two new ways to increase chip utilisation

As popular as it has now become, the "sea-of-gates" approach for improving chip utilisation in gate arrays and standard-cell designs is still not good enough for some circuit designers.

The sea-of-gates approach typically improves chip utilisation from 50 per cent to 75 per cent by eliminating the space wasted by under-utilized dedicated interconnections and running lines over or through the individual gates.

Still dissatisfied, two research groups at Mitsubishi Electric Corp., Itami, Japan, have developed alternatives that are even more efficient - one for bipolar master slices and the other for CMOS arrays. Both techniques were described at the International Solid State Circuits Conference in Anaheim, Calif., USA.

In the bipolar master-slice gate array, the designers used what they call a variable-size-cell approach to eliminate the wasted space that often exists in under-utilised cells in an array. In this approach, the array is constructed from basic cell units containing three transistor and four polysilicon resistors.

By changing the number of transistors and resistors, the size of the cell units can be varied to suit their task. The value of every polysilicon resistor for each logic function is determined, and the unused resistors are converted to intracell wiring by running a platinum-silicide interconnection line over them.

In the bipolar master slice fabricated using this technique, about 40,000 transistors and 53,000 resistors are grouped into 13,312 basic cell units. The master slice is fabricated using the company's silicide-base contact technology and four layers of metallization.

The first metal layer formed on the unused polysilicon resistors is Pt-Si, and the remaining layers are fabricated using aluminium-silicon and aluminium-silicon-copper silicide alloys.

In the CMOS array, the designers have developed a basic-cell-buffer approach that accommodates the 20 per cent of any semicustom design dedicated to input/output. This is done by implementing the I/O circuitry using the same basic cells in the periphery as in the internal array. In a 1.2-um double-metal CMOS array, almost 440,000 transistors are arranged in 126 rows of basic cell chains.

The CMOS chip has surge-protection circuitry built with parasitic lateral diodes formed between the source or drain region and the p or n well. Resistors are formed from the polysilicon gates contained in each basic-cell transistor pair.
(Reprinted from Electronics Week, 17 February 1986
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Offshore chip assembly

UCLA geographer Allen J. Scott has just concluded a study of the semiconductor industry in Southeast (and East) Asia. His report is to a large degree based on survey responses from 24 of the 63 US-owned assembly plants in the region and 17 of the 44 locally-owned subcontract assembly shops.

Today, with numerous firms carrying out testing functions in Asia, a division of labour is emerging within the region. Respondents told Scott that 41.9 per cent of the labour force at US firms in Hong Kong and Singapore was engaged in testing operations, compared to 18.2 per cent in the other countries studied.

Furthermore, capital intensity, particularly at US-owned factories, is gradually increasing. Measuring the capital intensity of the textile and printed circuit board industries in Los Angeles, Scott contends, "By these standards, US-owned assembly plants in South-East Asia today are not especially labour-intensive even though they do employ large (but diminishing) numbers of workers." He also finds, "Presumably, locally-owned plants cut back on quantities of fixed capital per worker as a way of minimizing the deleterious effects of [their] volatility."

Scott provides comprehensive, current (1985) data on the US and locally-owned semiconductor industry in eight countries in the region. The locally-owned plants include integrated - that is wafer fab as well as assembly - facilities in Hong Kong (4), South Korea (5) and Taiwan (8). In most countries, total employment has fallen significantly during the current slump. Scott's survey did not cover Japanese or European-owned factories.

1985 semiconductor employment by country

Country	US-owned No.	US-owned Employment	Locally-owned No.	Locally-owned Employment
Hong Kong	8	4,552	6	4,232
Indonesia	2	3,280		
Malaysia	14	38,136	2	1,450
Philippines	11	13,112	14	18,046
Singapore	11	18,397	1	240
South Korea	5	8,000	17	15,474
Taiwan	8	15,296	19	7,869
Thailand	4	6,470	2	900
Total	63	99,963	61	48,211

Scott also calculated average hourly wages in semiconductor assembly in each country, based upon his survey. Remember that the pay of workers in many countries includes daily, weekly, or monthly bonuses or living allowances. Consequently, the average hourly pay depends upon the length of the work-week, which varies with economic conditions.

1985 wages in semiconductor assembly

Country	Wage (US$)	No. of Firms	Employ.
Hong Kong	1.33	5	3,749
Indonesia	.35	1	1,800
Malaysia	.84	6	11,776
Philippines	.63	8	11,021
Singapore	1.58	6	4,263
South Korea	1.19	3	13,073
Taiwan	1.36	7	3,196
Thailand	.43	3	868

(Source: Allen J. Scott, "The Semiconductor Industry in South-East Asia: Organization, Location, and the International Division of Labour", 1985, Department of Geography, UCLA, Los Angeles, CA, 90024)
(Reprinted from Global Electronics, Issue No. 62, February 1986)

COMPANY NEWS

Gallium Arsenide:

NEC moves into GaAs ICs

Every manufacturer in the gallium-arsenide integrated-circuit business will have to turn a sharp eye on NEC Corp. now. The Tokyo company is poised to go to market with GaAs chips for designers who need the blazing speed of GaAs for critical paths in high-speed ECL-based hardware - test equipment, optical-communications gear, and computers.

NEC will start offering samples of three ECL-compatible GaAs chips in late February and follow up with a half dozen more in the spring. The packages are optimized to tap the highest-speed GaAs performance, but signal and power-supply levels are identical with those of silicon emitter-coupled logic. Initial price for the chips will be $253, says an NEC official, about twice that of 100K ECL circuits.

At the outset, then, NEC will be at the high end of the market. The two leading US producers of standard GaAs logic chips have comparable parts that list for less than $200. But NEC figures it can halve its prices when it gets into production and could then move into the market now dominated by Harris Corp. subsidiary Harris-Microwave Semiconductor, Milpitas, Calif., and GigaBit Logic Inc., Newbury Park, Calif.

NEC's first three chips will be a three-input OR/NOR gate, a D-type master-slave flip-flop, and a T-type master-slave flip-flop. The flip-flops operate at clock rates of up to 2 GHz, compared with a maximum of less than half that for silicon devices. Gates have a propagation delay of 250 ps, the flip-flops 400 ps. All devices feature a pulse rise time of only 130 ps and a fall time of 120 ps.

Hideaki Kohzu, engineering manager for the Microwave and Optical Devices Department of NEC's 2nd LSI Division, says the devices actually operate at higher frequencies but are rated at 2 GHz, because that is the test equipment's top limit. But to achieve that kind of speed, current drains from the -5.2-V power supply are fairly high. The gate draws 50 mA, the T-type flip-flop 60 mA, and the D-type flip-flop 70 mA.

The large frequency margin contributes to high yield. Even more important is a self-aligned fabrication technique that provides high transconductance - 250 mS/mm - and excellent drain characteristics without suffering from short-channel effects.

After selective silicon-ion implantation has converted the top 80 nm of a semi-insulating GaAs substrate to n-type, metal-semiconductor FETs (MES FETs) are fabricated on the n layer. Gates are a 0.8-um-wide stripe of tungsten silicide. NEC designers chose that material rather than the aluminium more commonly used in microwave transistors because tungsten silicide can withstand subsequent processes at temperatures exceeding 700°C. Aluminium's limit is 500°C. (Reprinted from Electronics Week, 10 February 1986, (c) 1986, McGraw-Hill Inc., all rights reserved)

Gallium arsenic memory commercialized

Hitachi has developed gallium arsenic LSI memories which have about 28,000 elements on a chip 4.7 mm x 3.7 mm. Response time required for memory input and retrieval is as short as 2.2 to 3.0 nanosec with power consumption less than half the level for silicon LSI. Since gallium arsenic pure crystals have been difficult to obtain, LSI element using this compound has been posing problems of characteristics instabilities. Hitachi has developed new circuit making technology and has succeeded in reducing the statistical dispersion to about half the conventional level. Hitachi's gallium arsenic memory is exchangeable with conventional silicon bipolar memories. As packaging technology is developed, the new memory will be able to replace silicon memories without design modification. Hitachi has so far been promoting development of gallium arsenic memory for use in a super computer project of the MITI. The success of the new memory is expected to be a firm step toward 16k bit memory planned for development by the fiscal year end. (Chemical Economy & Engineering Review)

Gallium gardens

Word is spreading: a new garden is blooming here in the central part of the Garden State. It is a technological oasis of gallium arsenide companies that together make up what is coming to be known as Gallium Gardens. Surrounded by AT&T Bell Laboratories, RCA Corp.'s Solid State and Research divisions, and universities with strong research traditions, the garden is in full bloom.

Two factors figure prominently in the nearly one dozen GaAs ventures - half of them started this decade - now operating in New Jersey. First was the breakup of AT&T and the changing atmosphere at Bell Labs, and second, the built-in advantages the state has to offer high-technology companies: an established service sector, a well-educated and trained population, and an excellent geographic location.

Lytel's Gordon led the charge out the door from Bell Labs. The 26-year Bell veteran took early retirement in 1983 to start Lytel, which he says was the first startup in the device area to come out of Bell Labs since 1959.

Almost immediately after Gordon broke with AT&T, others began to follow. Researchers broke off to begin Epi-Core and Gain Electronics Corp. Others left for new opportunities at Anadigics, Microwave Semiconductor, and others. "I don't want to take credit for starting a stampede," Gordon says, "but it's possible. If I had not left and done my thing, they might not have done it either."

Gordon acknowledges having hired at least 10 people from Bell Labs at Murray Hill, and says he is no longer a welcome visitor to his old stomping grounds. He says AT&T was "not tickled" by his hiring away Bell researchers, and it countered his actions with litigation seeking to prevent Lytel from doing business. The litigation ended with Gordon agreeing not to solicit Bell Labs employees for a year. Researchers at Bell Labs say their GaAs efforts have not been seriously affected by the startups, however. "People have always left Bell Labs," one says.

Other companies, especially Microwave Semiconductor, drew heavily from AT&T talent. Lederhandler says he has added more than 45 professionals since May, more than half of whom hold PhDs. He declines to specify how many of those came from AT&T, but he does admit that two of the top three people in his GaAs division were recruited from Bell Labs.

Microwave Semiconductor is aiming to be the brightest flower in Gallium Gardens. The Somerset, N.J., company is pouring $44.5 million into a three-year effort in GaAs power FETs, GaAs digital and analog ICs, and microwave monolithic ICs, or MMICs. The Department of Defense has promised to award a total of $120 million for research into MMICs in a program experts say will be for GaAs what the Pentagon's Very High-Speed Integrated Circuits programme, or VHSIC, has been for silicon.

Gallium Gardens is relatively compact, with Morristown as its northern tip and Princeton, some 30 miles away, as its southern end. Most of the growth has been in and around Somerville and the Plainfields, near RCA Solid State and Bell Labs' Murray Hill research center.

To the uninitiated, New Jersey might seem to be an unlikely locale for a technology center. But the state boasts some impressive statistics. According to its Department of Commerce, New Jersey has a well-educated population, with a citizenry that included 135,550 engineers and scientists in 1982 - a figure that, according to the department, is now "considerably larger". College-educated residents now account for 18.5 per cent of its population.

Although New Jersey's higher education system is small the state is surrounded by good engineering schools from which such companies as Microwave Semiconductor glean 8 to 10 trainees each year. Carnegie-Mellon and Lehigh universities in Pennsylvania and Cornell and Columbia universities in New York state join New Jersey's state university, Rutgers, in New Brunswick and Stevens Institute of Technology in Hoboken to provide talent.

In addition, the state is ideally situated at the heart of the East Coast corridor, relatively close to Washington, New York, and Boston. Being close to the nation's capital is advantageous to companies hoping to win government and military contracts, an area for which GaAs is well-suited. Being near New York, says Anadigics' Rosensweig, is important to v enture-capital investors based there who like to ke.. close tabs on the companies they invest in. And being near Boston is important because of the GaAs research under way at such companies as Raytheon Co.

Perhaps more important than these considerations, however, is that the state already has an infrastructure of service and support companies in place. Chemical companies, machinists, distributors, and other firms essential to new companies that cannot afford to maintain such operations internally are well established. The labour force includes people with experience in clean rooms and high-technology manufacturing, which keeps training - and associated costs - to a minimum. (Reprinted from Electronics Week, 13 January 1986, (c) 1986, McGraw Hill Inc., all rights reserved)

US-Japanese joint company for gate array production

Kawasaki Steel Corporation has agreed with LSI Logic of the US to establish a joint company to manufacture gate arrays. Kawasaki is the first Japanese steelmaker to start IC manufacture for business diversification. This attracts attention under the present competition between Japan and the US over semiconductors.

Both companies are said to find the co-operation beneficial because Kawasaki has been seeking new business areas while LSI Logic has a programme to establish a production base in Japan. LSI Logic will have a majority of stocks in the joint company.

Earlier, Kawasaki bought up a US silicon wafer manufacture, and started production in California. The company is planning to employ 100-200 employees initially to start the operation of the future to achieve total sales of 50 billion yen in 5 years. (Chemical Economy and Engineering Review, November 1985)

SCI pulls off a coup in Europe

Silicon Compilers Inc. 2/ (SCI) has staged its first commercial European coup through deals with two major silicon foundries. Both Austria Microsystems International (AMI) of Graz, and SGS-Ates of Agrate in Italy have said that they will process designs based on SCI's Genesil system. SCI will also be offering brokerage services using its Genesil software, with the tempting carrot of "guaranteed silicon" to draw new customers into the field.

The agreements with AMI and SGS-Ates will be crucial to Silicon Compilers' success in the European marketplace. Of the 200-300 chips which the California-based company expects to be designed on its systems this year, the number to originate in Europe must depend on the availability of foundry services this side of the Atlantic.

Recently the company also gave itself an image boost in the UK by donating a silicon compilation system to Imperial College.

.....

2/ See also Microelectronics Monitor No. 16, p.7.

Genesil, which runs on Vax, MicroVax, Apollo workstations and Daisy's Logician hardware, aims to bring logic design within the reach of systems designers.

Although said by some to be ahead of its time, the increasing complexity of VLSI circuitry and the increased interest in ASICs means that SC companies and CAD design houses are accepting silicon compilation technology as a necessary part of their future product development.

According to Tom Lawrence, European vice-president of Silicon Compilers, the key to real revival in European electronics "will be the extent to which systems engineers begin to design their own systems onto silicon chips themselves and then have the designs fabricated fast by silicon foundries".

SCI's current system supports 2-micron and 3-micron processor design in either CMOS or NMOS, and Lawrence said that the system has recently been used for 1.25-micron chip. (Electronics Weekly, 19 February 1986)

NatSemi introduces high speed 32-bit chip

National Semiconductor had started shipping samples of its second-generation 32-bit microprocessor CPU at the beginning of November 1985. Known as the NS32332, it offers users three times the system speed of National's first generation computing cluster based on the NS32032 CPU. The device includes a 32-bit address register, which allows the CPU to address up to 4 gigabytes of memory.

"The NS32332 combines a number of added on-chip features as well as expanded memory addressing capability, made possible by the use of smaller circuit elements and advanced processing technology," said Werner Trattnig of National. "It provides multiprocessing performance equivalent to that of super-minicomputers and mainframes, with the added reliability and cost factors of microprocessor technology."

With dynamic bus sizing, the 32332 can be used with 8, 16 or 32-bit data buses. It also has burst mode memory addressing capability which speeds up execution of data moves by 60 per cent.

The chip is currently being manufactured with a 2.8 micron proprietary NMOS process called XMOS, which is designed to achieve a 15 MHz clock rate. It contains the equivalent of 90,000 transistors on a die that measures 138,000 square miles. (Electronics, November 1985)

AT&T's new 32-bit chips

AT&T has officially begun to compete with Intel and consequently with IBM to win the 32-bit chip market by giving the green light to the production of a family of CMOS chips used in the manufacture of the WE32100 microprocessor, available with various speeds. The fastest one of the family uses an 18MHz (millions of alternations per second) frequency for its synchronization clock. Thus, it is even faster than the 80386 recently announced by Intel.

The latter can handle between 3 and 4 Mips (millions of instructions per second); has a real capacity of 4 gigabytes and a virtual addressing capacity of 64 T-bytes (thousands of billions of bytes; T equals 10^{12}). IBM, which is already using Intel's 80386 chips in the PC AT, has confirmed that also its next PCs will be using the latest family of Intel chips. The 80386s are much more powerful than those currently being used.

In its announcement, AT&T declared that the 14MHz chip has a capacity of 2 to 3 Mips per second; whereas the real addressing capacity proves to be 4 gigabytes (4 billion bytes, an address composed therefore of 32 bit). AT&T has further declared that the chip's design has been optimized to support UNIX and that its relative processing power has a value of "an equivalent VAX". (IBIPRESS-Bulletin No. 65, 26 January 1986)

AT&T's European invasion

After years of fumbled attempts to plug into international markets, American Telephone & Telegraph Co. is about to make a big connection in Europe. Soon after the French legislative elections on 16 March, AT&T is expected to sign an accord with Paris that will give it up to 16 per cent of the French telephone switch market, until now one of the continent's most fiercely protected. "This is a major coup for AT&T," says Edward M. A. Hier, an analyst with Dataquest U.K. Ltd.

AT&T can use one. The company's six-year effort to expand overseas is viewed by some critics as little more than a mishmash of deals, ranging from a computer network in Japan to telephone-book publishing in Thailand. A successful venture in France would mark a milestone in the company's struggle to score big abroad. It would also give AT&T a foothold in France just as pressure is growing to deregulate European telecommunications. AT&T could use the French accord as a key selling point as it goes after other international business.

At AT&T's international headquarters in Basking Ridge, N.J., President John E. Berndt is thinking big. Although foreign operations accounted for less than 5 per cent of AT&T's estimated equipment sales of $18.4 billion last year, his long-term goal is to generate 25 per cent of such sales. Berndt, who spends nearly half his time travelling abroad, seems to have AT&T headed in the right direction. Through its partnership with the Netherlands' Philips, which already makes telecommunications gear in France, AT&T is showing the kind of political savvy it has rarely mustered.

When the AT&T-Philips joint venture was first announced in 1983, it was maligned by French officials as a Trojan horse that would give the US company dangerous entree into Europe. Now, playing off French fears about losing jobs and the need to be in the US market to survive international competition, AT&T has persuaded the same officials to buy the idea. In return for a French market share worth about $150 million a year, AT&T will help nationalised switchmaker Compagnie Générale d'Electricité (CGE) sell its smaller, digital switches to US telephone companies. AT&T is also expected to buy $200 million worth of CGE equipment over four years. Although political bickering could still scuttle the deal, sources in the French government and the political opposition are confident it will go through.

Even without the French deal, AT&T-Philips is starting to gain critical mass. Its sales this year are estimated to hit $390 million, up 66 per cent in two years. Much of the business is from the Dutch telephone authority in Philips' home market. But it has also won small orders in Britain, Saudi Arabia, and Colombia that it hopes will lead to bigger things. Moreover, AT&T-Philips is a top contender for part of a $1.2 billion order expected to be announced in April in Indonesia.

AT&T's 1983 purchase of a 25 per cent stake in Italy's Olivetti may also be about to bear fruit. So far, Olivetti has gotten the best of the deal. AT&T sold an estimated 200,000 of the Italian company's personal computers in the US last year. By contrast, Olivetti sold only an estimated 700 to 900 of AT&T's minicomputers in Europe - less than a 1 per cent market share. But Berndt predicts that sales will increase this year because Olivetti has built up a strong distribution network for the computers. Indeed, Berndt is so confident that he recently signed up Olivetti to manufacture and market AT&T's office switching gear in Europe.

A key element of AT&T's international strategy is to capitalize on the vaunted technology of its Bell Laboratories. In February it gave Italian semiconductor maker SGS the European marketing rights for sophisticated computer chips developed for AT&T products and previously not sold commercially. The move follows a decision to build a $200 million plant in Spain to make chips for the products AT&T expects to sell in Europe. ... (Reprinted from the 10 March 1986 issue of Business Week, (c) 1986 by McGraw-Hill, Inc.)

Olivetti extends AT&T agreement

AT&T and Olivetti, Europe's largest indigenous personal computer maker, are to extend their co-operation to the design and supply of custom and semi-custom chips.

Both companies say that AT&T's new semi-custom chip centre, opened in Germany last month, will supply Olivetti with components and offer its custom chip design centre to Olivetti engineers working on new products.

This is a step forward for the relationship between AT&T and Olivetti, which began in December 1983 when AT&T bought 25 per cent of Olivetti. To date the two companies have marketed each other's products but had very little rapport over components.

Olivetti relies heavily on off-the-shelf chips, notably Intel processors, for its personal computers. Olivetti director of strategy Elserino Piol says the AT&T agreement offered Olivetti "particular advantages" to offer more tailored products using custom chips.

AT&T for its part is keen to promote itself in the merchant chip market. Although AT&T is a major producer of components, most are used internally, although AT&T already supplies AT&T and Philips Telecommunications, its joint venture with Philips. (Computer Weekly, 27 March 1986)

ES2 picks design centre sites in UK

European Silicon Structures (ES2), the customised chip venture launched last year, will shortly open design centres at Whitechapel in London and Bracknell. Among prospective customers for the company's products will be British Aerospace (BAe), which was one of seven leading European firms which recently announced that they had taken a stake in ES2.

BAe's share in the company is $5 million. A total of $36 million equity has now been raised from trade sources. The other investors are Brown-Boveri (Switzerland), Bull (France), Olivetti (Italy), Philips (Holland), Saab-Scania (Sweden) and Telfonica (Spain).

"No country has taken a major share," a company spokesman said. "We have gone for a balance between banks and participating countries and for pan-European funding on a one per country basis."

This sum is supplemented by a further $25 million from banks and institutions. ES2 is still exploring the possibility of establishing close links with a number of European universities.

When the company was launched it gave early 1987 as the target date by which its own facility would begin the production of customised very large scale integrated cmos chips. As yet, no site for this production facility has been finalised, though the French town of Aix-en-Provence is believed to be a strong contender. Until ES2's own production line starts rolling, the Californian company Exel will help to fill the gap. (Computing The Newspaper, 23 January 1986)

Philips teams up with CD

Philips and Control Data have formed a new company with expected revenues this year of over $100 million, rising to $300 million by 1988. The venture, which will be 51 per cent owned by Philips, will include Philips' Compact Disc Read Only Memory (CD ROM) activities, Control Data's tape drive business, as well as the previous joint venture between the two companies - Optical Storage International (OSI).

OSI, again 51 per cent owned by Philips, was set up in 1984 to design and market digital optical recording systems. Late last year, Philips also announced a major deal with DuPont - Philips DuPont Optical - under which the two companies essentially pooled their resources in the storage strategy - the tape drive technology.

Philips said that the operating divisions of the new company would remain unchanged. (Electronics Weekly, 12 March 1986)

Tandon tackles Asia as US pc "clones" rise

While US pc manufacturers worry about cheap Asian imports, a European-based pc distributor plans to tackle the Asian market.

Jogi Tandon, director of Tandon Computer, said the company intends to distribute its pc range throughout the Far East. It concentrates on the European IBM PC compatible market at present, with machines that use disk drives manufactured by its parent company. Tandon Computer's pc range has been made entirely in California but Juergen Tepper, director of European operations, says that its first pcs will be coming off a new production line in Singapore this week. The company has no plans to manufacture in the UK, he added.

According to recent reports IBM, Apple and Compaq, among others, could soon face competition from US dealers selling pc clones under the dealers' own names. Market research firm, IDM America, estimated that Asian manufacturers have seized at least 20 per cent of the $22 billion annual US pc market.

Romtech, which monitors pc sales in the UK can find "no evidence at the moment" of any Asian pc clones being sold here. Consultant, Marek Vaygalt, commented: "IBM is starting to sue over Far Eastern clones and dealers won't want to be caught in the middle." (Computing The Newspaper, 23 January 1986)

Second-hand computers

Need a "blue book" for used computers

Can you tell if a computer is a lemon? A lot more consumers will be asking themselves that as the used-computer business shifts into high gear. Earlier attempts at establishing such a market generally failed because consumers weren't confident enough to take a chance on used equipment. "Everyone purchasing a computer was a first-time buyer," says Dan Delmar, owner of Comp-Used, a Wilton (Conn.) listing service that matches up buyers and sellers of used computers, charging the seller a 6 per cent fee. Now, experienced personal computer owners are trading up to more powerful machines, leaving behind thousands of older computers that can be had for 20 per cent to 50 per cent off the price of a new model.

Stores that sell used computers are also cropping up. Pittsburgh-based Computer Renaissance is building a chain of franchised stores that will buy used computers from businesses, dealers, and individuals. The chain sells more than 40 computer models and publishes its own "blue book" of prices. Computer Renaissance President Steven Gold, who reconditions used equipment and offers a minimum 30-day warranty, likens his business to a used-car lot. "The only difference," he says, "is that computers don't rust, and they don't have odometers." (Reprinted from the 17 March 1986 issue of Business Week, (c) 1986 by McGraw-Hill, Inc.)

APPLICATIONS

Computer aids in electronic design

Computers are playing an increasingly larger role in the lives of electronics engineers. Right through the industry from school pupils and apprentices through to the integrated-circuit manufacturer there is a design tool that will aid the user to produce anything from a simple circuit or p.c.b. layout to a highly complex multilayer p.c.b. or i.c.

At the simplest level CAD is used purely to indicate the physical design of a p.c.b. or circuit where the designer has to provide all the component positions and the computer system can plot and interconnect them as indicated by the user. This is more like an electronic drawing board and can perhaps be better designated "computer-aided draughting". At the next level, the computer can be provided with a circuit and organise the components and position them to give an optimum layout design. At the ultimate level, especially in i.c. design, the user enters the inputs and the required outputs and the computer can then follow specific rules to design the circuit that will meet the requirements.

Not only can computers aid the designer to produce the circuit, but they can produce the necessary masks or etching patterns and be linked to automatic machinery to produce the finished product. They can provide a list of parts. They can simulate the circuit and check that it will perform the required tasks. I.c. design tools can also check that the circuit obeys the design rules and that stray capacitance will not damage the circuit.

Testing is an integral part of the design process. Design systems can test the circuit before it physically exists and then use the same test patterns to test the prototype and final product when it has been made. There is also a wide range of computer-aided testing (c.a.t.) equipment which is a separate branch in its own right. ... (Electronics & Wireless World, March 1986)

Automated roll information system for newsprint mill

A turn-key computer-controlled Rolldata system was started up recently for Donohue Inc. at its newsprint mill in Clermont, Que., Canada. The startup took only two weeks and progressed very smoothly. The newly installed system is used in the

roll finishing area, providing increased efficiency through its fully automated warehousing capability. Roll appearance is improved with a consistent labelling operation. Production, shipping, and inventory status are automatically recorded and updated. The system also communicates production run information and shipping records to the host computer at the mill.

The operator stations include CRTs and printers. At the order entry and accounting stations, Rolldata handles mill order, customer, and trim information, as well as location and current status of inventory. These may be received from the mill's host computer or manually entered and edited.

In the winder area, Rolldata gives full control of production sequence and number of sets ordered, and signals the operator when to complete trim. The Rolldata system creates roll data records and updates the trim schedule.

When the roll is on-scale in the wrapper area, the operator scans a bar code on the roll. The computer identifies the roll, reads the scale weight, assigns a roll identification number, stores the production data, assigns inventory, and transmits the transaction data to the host computer. Error signals are displayed for the supervisor's attention, as are weights, wrapping instructions, and storage zone destination. Roll labels with bar codes are generated. The system handles single rolls and multi-roll packs.

In shipping, the schedule is viewed on a CRT. The operator may specify a warehouse zone to be shipped as a unit or bar code scan the individual rolls to be shipped. Updated information is sent to the host computer.

Order entry and production and shipping information are automatically conveyed between the host computer and the Rolldata system. All information for the roll finishing process is contained in a real-time, fully redundant data base. The system is configured as a pair of computers which are completely redundant in hardware, software, and data. ... (Paper Trade Journal, January 1986)

Toxic waste control

A computer system to help operators of toxic waste disposal sites control and contain wastes is being tested at three toxic waste disposal sites. Lehigh University's Gemtox system should be ready for commercial use by mid-1986. The system can be accessed by an engineer via telephone. The engineer provides information about a hazardous waste disposal site's wastes, and general geological, hydrological and soil and rock mechanics data. The programme asks for specific information about geological formations, subsurface soil characteristics and climate fluctuations in the area. It then determines whether the site has the potential to contaminate groundwater or surface water, recommends particular field studies and provides recommendations on specific control or containment strategies. (Chemical Engineering News, 14 October 1985)

Computers control waste disposal

Tomorrow, most of Britain's waste-disposal officers will see a new computer system which could ease the country's waste disposal problems. Harbinger, as the system is called, was developed by scientists at Harwell. All the parameters related to waste management are fed into the system, allowing managers at the touch of a few buttons, to examine all possible ways of disposing of wastes. With the system managers can plan ahead for up to 20 years.

Dr. Philip Rushbrook, the senior scientific officer of Harwell's environmental science group, believes that Harbinger will prove a valuable legacy for whoever takes over the waste-disposal operations at the end of March when Britain's metropolitan county councils and the Greater London Council (GLC) are abolished.

The system has already proved useful in Hong Kong where it has been used to plan waste disposal for the whole territory - with a population of some five million - during the past 12 to 18 months. The initial development of Harbinger was financed by the Hong Kong Government. Since the early work in 1982, the project has been jointly funded by Harwell and the engineering firm Binnie and Partners of Hong Kong. (This first appeared in New Scientist, London, 16 January 1986, the weekly review of science and technology.)

Microcomputer in immunological tests

Genenchem has developed a dedicated microcomputer to interpret the results of immunological tests. TiterCalc could cut the time of such tests from two hours to two minutes. Most immunological tests use a spectrometer to analyse samples to which antibody has been added. It takes time to plot all the results of various samples and calculate the concentration of the target molecule. Genenchem says that 70 per cent of all molecular biology and clinical labs do at least 10 of these assays/day. (This first appeared in New Scientist, London, 10 October 1985, the weekly review of science and technology.)

PC for process control

Personal computers are being adapted for use in process control and monitoring. Fisher Controls Intal has developed a PC interface to allow Digital Equipment PCs to be used to control Fisher's distributed process control equipment. Cyborg's Isaac 5000 interfaces between process sensors and IBM or Apple IIe PCs. A high-speed option can handle 200,000 samples/sec. Allen-Bradley has introduced a new T50 industrial terminal for use with the IBM-AT PC and a statistical software package to record, analyse and display data from industrial processes. Rosemount's new System 3 distributed process control system does not require a supervisory computer. Texas Instruments' new PM550C programmable logic controller provides most of the batch features of a distributed process system. Other instruments recently introduced include Texas Instruments' intelligent hydrostatic tank transmitter that monitors tank level, temperature and density with no moving parts; Beckman Industrial's hydrocarbon analyser and oxygen analyser and NDA Scientific's continuous toxic gas monitoring system. (Chemical Week, 30 October 1985)

Wine tasting

Are wine tasters about to become redundant? Objective computerised tests are challenging the delicate and subjective art of judging wines by mouth. Developed by the Dutch Food Analysis Institute in Zeist, the new tests employ chemical detection to identify wines by area and by variety.

To work out a wine's area of origin, researchers use a standard piece of laboratory apparatus, called an atomic absorption spectrometer, to determine the concentrations of a wine's trace elements. As the soil of each wine-producing area contains a characteristic combination of these trace elements that ends up in the grapes, the district can be identified by analysing the wine.

This is done with the aid of a computer which uses pattern recognition to analyse the tell-tale trace elements. Raw data are extracted from the wine. Establishing correlations between different bits of the data makes it possible to reduce the initial information to more recognizable clusters or patterns. This produces a unique "fingerprint" for each different area.

Dr. Henk Maarse, head of the institute's flavour division, is working on a comprehensive screening system to assess the overall composition of different wines from different areas. This could detect wines adulterated with cheaper varieties or with synthetic aromatics such as diethylene glycol.

Here the Dutch institute faces some competition. Hewlett-Packard, a Silicon Valley computer and instrument firm, has just announced a detection kit for diethylene glycol, which will register its presence in concentrations as low as one part in 100,000. It too uses gas chromatography to separate out the organic components of the wine. As the different compounds are drawn off by heat, any diethylene glycol can be picked up by an extremely sensitive detector.

Dr. Maarse's machine would go further. He envisages the test's two stages - chemical analysis and pattern recognition - being linked so that wine constituents fed in at one end produce print-outs identifying the wines and their origins at the other. But the necessary computer library of wine fingerprints will take years to develop. More than 600 different organic compounds are present in wine.

Such a test, when it arrives, could team up with an existing data-processing and weighing system which provides growers with detailed information about harvests and where the grapes from different growers are stored. Developed by Philips, the Dutch electronics multinational, the Receptel system was installed recently in the Nuits-Saint-Georges area of Bourgogne where French growers may not produce more than their allotted quota of grapes per hectare. In each village the quotas are decided by five "wise men". They assign a limit on the harvest of each grower on the basis of prevailing weather, soil conditions and local vine diseases.

Operators of the system, who use a weighing unit, computer and printer, record each quota. Then, at harvest time, each grower's contribution is weighed. A refractometer determines the alcohol level and sugar content of the grapes. This makes the awarding of "origin appelations" a more objective art - though the final distinction between different blends of wines may still remain a job that wine tasters do better than computers. (The Economist, 15 March 1986)

Electronic tag tracks salmon

Scientists from the National Marine Fisheries Service in Washington State are experimenting with a new way of tracking migratory salmon. Before juvenile salmon leave the hatcheries, scientists inject them with a tiny electronic tag. The tag responds to a 400-kiloherts signal emitted from monitoring points in dams along the Snake and Columbia rivers.

An antenna on the tag picks up the signal from the monitoring points and through induction current drives the circuitry of the chip. Each tag contains a microchip that is programmed to emit a unique signal when activated by induction.

The survival, distribution, and migration rate of the salmon is recorded without having to handle the fish during their journey to the sea. Excessive handling can cause stress and death.

The information collected will be filed on computer. Later this year, scientists will be able to call up the history of individual fish as they migrate.

In the laboratory, the scientists will study the effect of the tag on the fish and determine the minimum size that could be impregnated with the device.

The package containing the antenna and microchip is 10 millimetres long and 2.1 millimetres in diameter. It is called a passive integrated transponder, and was developed by Identification Devices of Denver, Colorado.

The Bonneville Power Administration is financing the work because the organization is responsible for finding out what effect hydroelectric power plants have on migratory fish. (This first appeared in New Scientist, 16 January 1986, the weekly review of science and technology.)

A crowning achievement: computerized dentistry

Computer-aided manufacturing may soon come to the dentist's office - and getting a tooth crowned will never be the same. Gone will be that lockjaw feeling while a mold is made of your mouth, gone the need to return once or twice to have the crown fitted. Instead, the dentist will make a digital "map" of your teeth, then use that map to turn out a replacement tooth on the spot with a precision-milling machine.

The system is the brainchild of François Duret, a 38-year-old dentist from Grenoble, France. Using his wife Elisabeth as a guinea-pig, he recently demonstrated it for a gathering of dentists. Duret first poked a so-called optical probe into Mme. Duret's mouth. The probe, not much bigger than a cigar, was hooked up to a Digital Equipment Corp. minicomputer. A three-dimensional image of a row of teeth appeared on the screen, including the lower-right premolar that needed crowing. Then the computer designed a crown and guided the grinder in making it. The whole process took about an hour.

Duret, who has spent 14 years working on the concept, has joined with Hennson International, a startup in Vienne (near Lyon), to market commercial systems expected to start at $18,000. Hennson is looking for partners in Japan and the US, where it hopes to hit the market by early 1987. (Reprinted from the 23 December 1985 issue of Business Week. (c) 1985 by McGraw-Hill, Inc.)

Computers in the basement

When energy-conscious Swedes talk about their home computers, they may mean the machine in the basement that controls their building's heating. The device, called Diana, is a spin-off from research at the University of Linköping, in southern Sweden.

Sweden has installed 130,000 heat pumps of different sizes over the past three years. They take heat from air or water outside a building, and put it into the building's heating system. Although heat pumps are cheap to run, they are expensive to

buy. "So you want to run them as often as possible," says Bengt Bengtsson of the university. In large buildings, this creates a problem of control. Electromechanical switches will always switch on the first in a line of pumps, for example, rather than balancing the load. A computer, however, should easily be able to make the right decisions.

Bengtsson first developed a numerical model and then a programme to work on existing machines. But he could not find a computer to handle enough channels of digital and analogue data simultaneously, so he designed Diana. The machine can handle 40 channels of data, from sensors and to controls. (This first appeared in New Scientist, London, 6 February 1986, the weekly review of science and technology.)

A handheld computer emerges as the warehouse worker's friend

Desktop personal computers have helped automate tasks for millions of office workers. But what about the millions of employees in factories, warehouses, and other workplaces where a desktop computer, or even a portable, is impractical? National Datacomputer Inc. in Billerica, Mass., thinks it has the answer: the first handheld computer that is compatible with the IBM Personal Computer.

Like existing handheld data collection terminals, the two and a half pound Datacomputer lets a warehouse or factory worker quickly gather data for a computerized inventory or materials-handling system, eliminating the need for paper forms. But the $2,995 Datacomputer promises to be far more flexible than a simple data terminal. It can be programmed from any IBM PC using conventional computer languages rather than the proprietary systems used for data terminals. According to officials at National Datacomputer, a new division of 18-year-old Computer Systems Engineering Inc., that feature should make it easier for customers to tailor their programmes as needs change. (Reprinted from the 24 March 1986 issue of Business Week, (c) 1986 by Mc-Graw Hill, Inc.)

Pattern recognition for welding inspection

Bharat Heavy Electricals Ltd. (BHEL) R&D Division will utilise pattern recognition and image processing methodology for welding inspection. This is one of the techniques of non-destructive testing (NDT) where pattern recognition and image processing is useful. Other techniques used involve machine vibration, eddy current, ultrasound, and acoustic emission. These sensors provide important information about the integrity of critical components, e.g. drilling machines, aircraft wings and pacemakers. Automated techniques for NDT could be an important area for developing countries where the maintenance of machinery, power plants and structures is crucial.

The decision taken by BHEL is partly based on UNIDO's report on Applications of Pattern Recognition and Image Processing to Industrial Problems in Developing Countries, 3/ prepared for UNIDO by Professor A. K. Jain of Tata Research Development and Design Centre, Pune, India.

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3/ UNIDO/IS.609, 14 February 1986.

FACTORY AUTOMATION

In pursuit of CIM

CIM, or computer integrated manufacturing, is a strategy for winning in manufacturing. CIM is the sharing of manufacturing resources related to information collection, storage, processing, and distribution in such a way as to optimize the performance of the total enterprise. This includes the information necessary to control production equipment. The good news is that CIM is available to anyone; the bad news is that you may have to chase a few rainbows before you find this particular pot of gold.

CIM's attractions are many, including:

- Uniform easy access to business, engineering, and factory data,
- Minimal data redundancy,
- Simpler updating of data by eliminating currency problems,
- Timely availability of new product design and engineering change notices to all, and
- Realization of a true closed-loop control system in which automated production and materials handling equipment are tightly coupled to the manufacturing planning and control system.

It sounds like a good idea, and it is. But before you run down to the corner store to buy a box of CIM, take a look at what's involved. CIM's promised payoff is based on the assumption that a measurable improvement in data accuracy and consistency will be derived from sharing computing resources across such traditional functional boundaries as marketing, engineering, materials, production, quality assurance, accounting, human resources, and general management. The implications of this assumption are considerable. This article aims to shed light on them by discussing a particular environment that, on the surface at least, would appear to need CIM.

The Microelectronic Circuits Division (MCD) of Hughes Aircraft Co., Long Beach, Calif., currently assembles a variety of hybrid microelectronic circuits. MCD operates in a vertically integrated manufacturing network; the division buys substrate and semiconductors from a sister division and sells hybrid circuits in small, ruggedized packages to Hughes divisions that make larger systems. The hermetically sealed packages contain semiconductors and other miniaturized components. About 120,000 circuits are produced per year, in some 400 different varieties, generating around $75 million in sales.

Hughes MCD recently analysed the factors that drive microcircuit costs and determined that the technology of advanced manufacturing concepts such as CIM was needed to achieve the quality, productivity, and cost performance levels demanded by the marketplace. Progress to date has resulted in two continents of automation and several islands.

The two continents are made up of applications groups that execute on either the business or the engineering computer. The business computer is an IBM 4381 running MOS and CMS under VM. Components of the manufacturing resources planning (MRP II) system executing on the business computer include

the homegrown sales order and purchase status systems, as well as IBM COPICS modules related to bills of materials, master production scheduling and planning, inventory accounting, materials requirements planning, shop order release.

The engineering computer is a DEC VAX 11/785. It is used to support circuit design and analysis as well as physical design. Virtual terminal access to the VAX is provided by an AT&T System 85 switch and an Ethernet LAN. There is a bridge to another division's engineering computer.

The several islands include an automatic materials transport system that is manually serviced by flow racks. An automatic storage and retrieval system is installed and is being checked out as a replacement for the flow racks that currently store the work-in-process (WIP) inventory at the head of the computer assisted manufacturing (CAM) line. The CAM line is populated with a mix of automatic assembly and test equipment from General Electric, Hewlett-Packard, and Hughes Industrial Products Division. A second, scaled-down CAM line serves as a test bed, or proof of manufacturing (POM), line. It is the POM line where all new production equipment and computerized control systems are verified.

Compared with most installations, Hughes MCD is a technologically modern electronics manufacturing plant. Yet the division's senior management has cause for concern. Competition is pushing the state of the art. In this division's relatively short history, there have been major changes in the product line. At one time the division made components for digital watches; now it makes hybrid circuits. The managers know from experience that today's winning product may not be tomorrow's. The strategy for survival is to be a custom shop.

To pursue the custom shop concept, Hughes MCD set up a CIM program under its Productivity Engineering Department. The program staff determined that Hughes MCD's highest priority in the near term should be to implement the missing element of its manufacturing resources planning (MRP II) system. This determination led to creation of an advanced shop floor control (SFC) system project.

There are three categories of SFC system requirements: functional requirements, performance requirements, and advanced CIM architecture.

The SFC's functional requirements can in turn be subdivided into four elements: configuration control, priority control, capacity control, and data collection. The configuration control element must ensure that each product is produced to the proper engineering revision level, and that the traceability requirements are met. Configuration control implies, therefore, that all maintenance to released product designs, process plans, production line equipment, and workstation staffing authorizations must be evaluated in terms of mutual dependencies.

The priority control element must provide the ability to accept and maintain manufacturing orders that have been released to manufacturing production by the materials planners. It must also provide detailed scheduling by work centre, provide a daily dispatch report, assign work to workstations based on priority, and provide manufacturing order status on demand.

The capacity control element must report exceptions, which are identified when actual capacity utilization deviates from planned utilization. An input/output control report is generated to highlight variations in input and output volume.

The data collection element must capture all of the atomic level data needed to serve both managerial accounting and financial accounting. The factory data terminal (FDT) must support both keyboard and bar code input. The FDT must also support icon-oriented instruction displays.

The shop floor control system's performance requirements are determined by the time-critical interaction between the workstation operators and the processor executing the SFC system. Routine transactions are expected to have response times of less than one second. On the other hand, query response times will obviously depend on the complexity of the query and the internal data structures.

Up to this point, the Hughes MCD SFC system looks much like other SFC systems. What sets it apart is its emphasis on an "advanced CIM architecture". This emphasis includes the linkages needed to integrate the SFC system with the automatic materials handling equipment and the computer aided manufacturing line.

As the cornerstone of its advanced SFC system, Hughes MCD selected and installed a Stratus/32. This 32-bit, fault tolerant computer series is designed for uninterrupted operation without data loss or performance degradation and without any special applications software requirements. The fault tolerant architecture and transaction processing orientation of the Stratus VOS (virtual operating system) matched nicely with the requirements of the advanced SFC system.

The advanced SFC system will be interfaced to (as opposed to integrated with) the business planning systems on the IBM 4381 and the engineering system executing on the DEC VAX. The physical path for these interfaces will be high-speed communication links capable of supporting peer-to-peer session protocol.

On the shop floor, IBM PCs will serve as the standard factory data terminal. These terminals will perform the dual functions of interfacing to the workstation operator and serving as a store-and-forward network node to interface to CAM line equipment. The IBM PCs will connect to the Stratus (either via a LAN or directly; the choices are still being evaluated) and to the CAM line equipment (via a high-level protocol that also has yet to be determined).

This is the environment, and the near-term plan for it. But even this limited step toward CIM produces problems, most of which are intertwined technical and management issues. Because many technical details are not yet resolved, the scope (and therefore the cost and the schedule) are somewhat open-ended.

Concern over the added complexity introduced by the integrated architecture causes division among the project sponsors. Some believe that the pursuit of CIM is too risky, and that conquest of more islands is the way to go. Others argue convincingly that if integration is abandoned in favour of an additional independent system, the resulting open-loop control system will be uncontrollable. No one seems to know how to quantify the value of a closed-loop system.

Over the past several years, many people have called for users to manage system development projects. The dp shops were glad to share the responsibility for getting systems correctly defined and implemented, and grass-roots support for CIM projects is now quite evident. But this raises a whole new set of problems.

The first is that these grass-roots projects sometimes have too narrow a support base to appreciate the proper systemic relationships. Now we have the dp people representing the technical view and the users representing the user view. But we still are not getting enough of the enterprise view.

When we do get the enterprise view, it may not be compatible with either the technical or the user views. For example, in corporations like Hughes, where there is strong emphasis on solving problems and controlling costs at the lowest possible level, it may be difficult to get corporate support for broad concepts like CIM.

There is also the problem of getting sufficient funding for the development and implementation effort. A small division like Hughes MCD could easily spend 10 per cent of its annual sales on a project like an advanced shop floor control system. Since software development costs are not capitalized at Hughes, division managers need strong evidence that an investment in CIM will deliver the promised benefits.

Because many of the benefits of CIM are expected to result from the whole turning out to be greater than the sum of its parts, this strong evidence is hard to come by. After all, islands of automation are merely elements of an open-loop control system. The loop might also be closed through manual intervention or through automatic linkages and shared data. It is very difficult to quantify the advantage of an automatically closed loop over a manually closed one.

Another difficulty is that departmental barriers have been in existence for some time. The flow of information is much greater within material control than between, say, materials control and production planning. So the value of a common, integrated database is not readily apparent. In microelectronics manufacturing, there isn't even a strong need for design engineering to be tightly coupled to process engineers. While producibility tips must be communicated from process engineering to the product designers, a better way to do this might be a shared model that design analysis could use to identify violations of producibility standards. In this way, design analysis might evolve to an expert system.

Moreover, engineering and management systems require different computer hardware attributes. Engineering requires immediate response to maintain creative momentum related to design engineering, and a very powerful cpu to accommodate matrix manipulations. Management systems, on the other hand, demand fast sequential processing of relatively large amounts of data.

Factory control computers must be extremely reliable and also capable of time-critical transaction processing. For these reasons it is probably unwise to integrate the computer hardware per se. This will be true at least until associative memories are cost-effective and computer power is measured in BIPPS (billions of instruction per pico second).

The third problem is related to obtaining consensus within a decentralized production environment. Once a manufacturer achieves the goal of becoming a custom shop, the manufacturing control system will need to be generalized and table-driven to accommodate many manufacturing environments under one roof. But the cost of generalized software is greater than the cost of specialized software (disregarding the cost of undesirable duplication). Small operating units can't afford to build generalized software, and the corporate culture may not support standardized, generic, packaged solutions. The result has been the proliferation of many different and highly customized manufacturing control systems. So the corporate element won't develop CIM support software and the operating units can't. (By David L. Dutton, a senior consultant for manufacturing systems at Hughes Aircraft Co. in Long Beach, Calif. on 1 February 1986). (Reprinted with permission of Datamation magazine, (c) by Technical Publishing Company, A. Dunn and Bradstreet Company - all rights reserved)

The CIM connection

While there are many examples of modern on-line factories approaching a true computer integrated manufacturing (CIM) state in the world today, the sad truth is that the great majority of senior managers (chief executive officers, chief operating officers, vice-presidents) of the world's manufacturing companies have not come forth to embrace and promote CIM in their companies. In this article, we'll explore the many reasons for this impasse and offer some ideas on how to get top management support for CIM.

At the outset, top management enthusiasm for CIM is hampered by the term computer integrated manufacturing itself, and, more specifically, by the word computer. Too many executives still view the computer as an enemy, not an ally, and as a cost, not a competitive asset. While this view will change as more computer-oriented executives come along, the presence of the word computer often obscures the most important word in the CIM concept - integrated. Computers and modern information technology are merely tools that allow the integration.

Thus, to diffuse any initial negative reaction to CIM, it is often beneficial to relabel it with a broader conceptual term such as modern integrated manufacturing (MIM). MIM is shown supported by its three basic components - CIM, total quality control (TQC), and just-in-time (JIT) production principles. Moving from a focus on CIM to MIM has the added advantage of shifting manufacturing to a more strategic conceptual level and away from the shop floor level it currently occupies in many executives' minds, i.e., isn't CIM just more manufacturing automation?

Then too, we must change the narrow way in which executives consider the scope of manufacturing. All too often, senior management looks at the term manufacturing as meaning production only. Thus they think MIM applies only to a very narrow segment of their operations.

Joe Harrington, the father of CIM, has established as a basic CIM tenet that manufacturing includes the entire spectrum from design through production through distribution to aftersale service and support in the field. By treating this as one continuous spectrum, we encourage consideration of the total manufacturing process and can evaluate total cost, total system solutions. Furthermore, promoting this view helps enhance intracompany communication and co-operation by eroding the many walls company management has built around functions in their organization.

Much of the problem of enlisting top management support for MIM lies in the background of the typical US manufacturing company executive officers. Studies have shown that most of them come from legal, financial, or marketing backgrounds, although more are coming from manufacturing lately. (In Europe and Japan, more executives have

traditionally come from technical backgrounds.) As a result, most US top executives just aren't all that interested in manufacturing. They don't understand manufacturing as it was five to 10 years ago, much less as it will have to be five to 10 or even 20 years in the future.

This isn't meant to be a slight against these executives - manufacturing just isn't their bag. Many of them are used to viewing manufacturing as a cost centre with relatively fixed performance characteristics. The company's products that are this cost centre's output are often too late, too expensive, of insufficient quality, or all of the above. Top management has to be made aware of the fact that MIM offers benefits that allow us to change the performance characteristics of manufacturing so that a manufacturing company can gain and maintain competitive advantage in global markets.

Yet, the mention of manufacturing strategy runs up against another roadblock at senior management levels. If there is any appreciation of manufacturing strategy at senior management levels (how many manufacturing companies have a clearly articulated and communicated statement of manufacturing strategy?) it is liable to be focused on traditional concepts of manufacturing strategy.

These deal with decisions about vertical integration, production technology, plant location, capacity, production systems, labour force composition, etc. Many executives tend to view these as one-time decisions that, once made, need little reconsideration - maybe a perfunctory review every five to 10 years. In reality, making decisions on these items is an ongoing process as technology, costs, and global competitive conditions change.

While these traditional manufacturing strategy views are important, they fail to consider the daily bases of competition in manufacturing - the way companies are measured in the market place as well as in their financial reports. In football, what counts in the end is how well a team blocks, tackles, passes, kicks, and runs, and blends these basics into an overall competitive resource.

Analogous measures of manufacturing performance include such fundamentals as:

- New product development lead time,
- Cumulative manufacturing lead time,
- Inventory turns,
- Quality levels, and
- Total cost per unit of production.

Senior managers must continually pay close attention to manufacturing strategy objectives that address these bases of competition in their industry. The constant focus of their thinking must be to search for competitive advantage in these fundamentals of manufacturing by which they are measured in the real world. In short, manufacturers must face the fact that, ultimately, they compete on the basis of their manufacturing capability.

Too often, senior managers view CIM or MIM as a technical matter to be delegated to the lower, more technical levels of management. Isn't TQC just inspecting parts better? Isn't JIT merely rearranging lines or reducing setup times? Isn't CIM just hooking a few computers together on the shop floor? Obviously this is a simplistic view of MIM. What is so frustrating for many executive officers is that CIM keeps bubbling back up to them time and again after they thought they'd solved the "problem" by delegating it away.

In years past, lower-level managers were able (and allowed) to buy individual machine tools, computers, or other equipment. Now, and increasingly in the future, as all these pieces of production machinery, design equipment, material handling equipment, and computers must fit into subsystems and, in turn, into a total MIM system, no one department head should make an independent buying decision for equipment or systems that do not fit into an overall corporate MIM plan. As the systems to be bought become larger and cut across a wider number of company functions, the buying centre has moved up commensurately. Only the company's executive officer and chief operating officer (or even the board of directors) can make such companywide buying decisions. Moreover, the cost of such larger systems is such that top management must approve such large expenditures. Decisions about MIM planning, implementation, and spending will increasingly end up on senior management's desk. Company executive officers cannot delegate the MIM problem away.

Many top managers' foot-dragging on MIM seems to stem from their belief that MIM can't be financially justified. Their thinking is tied to old-fashioned investment formulas, e.g., return on investment (ROI) and net present value (NPV), equipment justification, and a short-term financial outlook that neglects consideration of strategic benefits (flexibility, reduced new product development lead time) and long-term competitive success.

When viewed as a total program, MIM can be financially justified by current ROI or NPV formulas. The root of the so-called cost-justification problem is that most companies never approach MIM from a total program viewpoint. Most existing MIM plans are generated in a bottom-up process and thus lack the vision, scope, strategic impetus, and cohesiveness necessary to gain competitive advantage in world markets. Total MIM programs have overwhelmingly attractive financial and strategic payoffs.

In many cases, it is important to view the cost of a total MIM program at the margin. There are many projects in a MIM program that will overlap or duplicate capital spending projects already planned or allocated for in a company's five-year capital plan. Often, MIM planning efforts involve a redirecting of existing plans, especially in highly decentralized companies. Thus, it is important to net these costs out of the total MIM program cost.

Often, top management may want to support MIM but they simply are overwhelmed by "solution" input. They are in a state of paralysis because they don't know which of the many MIM solutions offered by their own people, consultants or vendors, is the right one.

To add to this confusion and paralysis, most companies lack the organizational structure or staffing that gives any one individual the charter to pull together the entire MIM picture. Proposals for parts of the MIM solution come from many different sources within the company. Thus, top management never gets to see a total MIM program, its total cost, or, in particular, its total benefits.

Finally, many top managers are too isolated from the tremendous pace of technological change occurring in the world today - in their industry as well as in others. Not only are they unaware of

progress in manufacturing in other industries and countries, but they often don't sufficiently appreciate the progress (or lack of it) evident in their own design centres, plants, or distributing centres. For them, a trip to a plant is a whirlwind tour of a notified-in-advance, spit-shined facility with little dialogue exchanged over real-world, day-to-day manufacturing problems. Many executives are not sufficiently involved in their core business - manufacturing. ...

People are the main impediment to MIM implementation. We have more technology available than the average company could implement in the next 10 years. People resist change and often lack the knowledge necessary to change. Only education and training will overcome these human problems at all levels of the company. Note that this entire article really deals with the education and training of senior management!

Both words, education and training, should be given full consideration. Training is the how, education the why. Often, with regard to manufacturing modernization today, the why is as important as the how, from senior managers to shop floor employees.

Experience shows that companies should be prepared to spend in excess of $1,000 per worker per year in an ongoing education and training program to support the technical and cultural change necessary for MIM. Such an ongoing program generally represents 5% to 10% of the cost for MIM capital equipment. Top management must be prepared to spend an order of magnitude more than most of them are used to spending to ensure that all their people are educated in the strategic, technical, and people-oriented matters that are so vital to maintaining a company's competitive edge in the future.

It is clear that there is no magic wand to ensure competitive supremacy in manufacturing or to get top management support for MIM. To obtain both is a combination of continual education, training, and just plain hard work. Such efforts, devoted to harnessing people and technology in support of a company's strategic objectives, is the only way to ensure future competitive advantage in global markets. (By Thomas Gunn, a partner with Arthur Young, Cambridge, Mass., where he is the national director of its Manufacturing Consulting Group. He was formerly a vice-president of Arthur D. Little Inc., where he managed its CIM Group from its formation in 1981. Datamation, 1 February 1986) (Reprinted with permission of Datamation magazine, (c) by Technical Publishing Company, A. Dunn and Bradstreet Company - all rights reserved)

JIT is OK!

A design and production philosophy adopted by a British manufacturing company shows that "right first time" and "just in time" (JIT) techniques are not necessarily bad news for sub-contractors. As reported in the January 1986 issue of associate journal Eureka, a redesign of an industrial disc brake by Hagglunds - a product line abandoned by its Swedish parent - resulted in a product that is stronger, has increased capacity and is less expensive than its predecessor. In fact, the project has been so successful that the brake has been re-introduced into Sweden, and exclusive production for world markets is likely to be carried out at the Wakefield-based subsidiary.

The benefits for the sub-contractors involved in producing these safety-critical products include reduced reject rates (up to ten-fold in one case).

So how was this achieved? Basically by Hagglunds taking a hard look at the product, the market and the skills within the company - from which a "design for manufacture" approach was distilled.

When reviewing in-house skills, Hagglunds concluded that the company had a deserved reputation for high quality products, achieved from a workforce trained in skilled assembly work. Design and production engineers already worked well with existing component suppliers, so it seemed logical to adopt a "just-in-time" approach to manufacture in which finished, fully inspected components are delivered ready for final assembly, product testing and packaging.

The dilemma, of course, lies in establishing and building a relationship with suppliers willing to accept the method of working. For, in effect, they are having to bear the burden of maintaining inventories of stock and consistent high quality levels.

This work is carried out at agreed times and to an agreed standard on each manufacturing site. Hagglunds claims many advantages, the main ones being:

- It satisfies a policy of full traceability of components parts, which demands 100 per cent NDT.
- Inspection can take place at convenient times.
- Costs of quality, inventories and work-in-progress can be quantified.
- All parts can be assembled without fear of rework or rejection due to incorrectly manufactured components.

(Machinery and Production Engineering, 15 January 1986)

IBM puts up cash for focus for CIM

A national focus for computer integrated manufacturing (CIM), paid for by IBM, is to be set up at Cranfield Institute of Technology. It will cost £3.6 million over the first three years with nearly £3 million coming from IBM.

Another boost for CIM in the UK is coming next week, when Salford University will announce a similar initiative - also in partnership with industry. Salford vice-chancellor John Ashworth says this will cost more than the Cranfield venture.

IBM hopes that its part in setting up the CIM institute at Cranfield will help to expand its CIM marketplace in the UK.

John Fairclough, IBM UK director of manufacturing and development, says that IBM is trying to sell CIM, but IBM and its customers need staff trained in CIM techniques. He adds that the UK "must understand and implement CIM if it is to be competitive in the international market". Cranfield's CIM institute will be an independent educational charity.

However, it will also work closely with the Cranfield College of Manufacturing, which Sir Henry Chilver, vice-chancellor of Cranfield, claims is the largest teaching and research centre for manufacturing technology in Europe. IBM and Cranfield hope to entice other manufacturers to take part in the CIM project.

Chilver says the aim is to become "a national focus for advanced teaching and research in CIM, drawing together, eventually on a network basis, the expertise in this important technology in the UK universities and manufacturing industries".

The CIM institute opens its doors in October. A start has been made on purpose-built accommodation. Specialist staff will be seconded from IBM to assist in setting up and operating the institute. (Computer Weekly, 6 February 1986)

BL and ICI put weight behind CIM

The computing subsidiaries of motor group British Leyland (BL) and chemicals giant ICI have launched computer-integrated manufacturing (CIM) packages, and warned that CIM is a necessary long-term manufacturing strategy.

"We always say that companies must have a grand strategy for the use of CIM," says Mike Grant, head of BL subsidiary Istel Automation. "But if they are not committed to it from the chairman down, they can end up with fragmented systems."

His words are backed up by Geoff Critchley, project manager at ICI subsidiary Industrial Efficiency Systems, which has just enhanced its Auditor performance monitoring system to "bridge the plant-end gap in CIM".

Critchley says: "It's not easy to bring in CIM in a small way. It's important that companies have an idea of where they are headed when they want to introduce CIM; they need a long-term view".

Istel Automation has launched Mandate, a package running on DEC Vax systems, with two modules: Tracker, for online monitoring of work in progress; and Tardis, to provide online data about manpower allocation.

The releases come just a week after the news that Cranfield Institute of Technology is setting up a £3.6 million centre to provide a focus for advanced teaching and research in CIM. Nearly £3 million will come from IBM.

Grant remarks that there is "no shortage of work" installing CIM systems; "companies are obviously investing in it". But he is unhappy that "few companies believe a CIM strategy is as important as a research and development strategy or a marketing strategy".

Both BL and ICI are increasingly users of CIM, and both rely on their subsidiaries for their systems. Yet the future buyers of CIM systems are probably UK manufacturing firms, which at present are using manual systems. ... (Computer Weekly, 13 February 1986)

Factory of the future

General Electric's Motor Business Group is installing a flexible manufacturing cell for producing fractional motor shafts at its plant in Ft. Wayne, IN. The cell designed by GE and ITP Boston Inc. (Cambridge, MA) includes three machining centres connected by conveyors, a turning centre, a milling centre and a grinding centre. The turning centre has a CNC lathe with automatic bar feed, a second turning machine and an automatic gauge, the grinding centre has two robotically-fed grinders and the milling station has one machining centre and a robot. It will be used to produce 400+ different parts in small batches, the parts 1" in diameter but varying 8-20+" long.

Although GE decided to design its own station, a turnkey supplier might be considered for future cells installed as the knowledge gained through the experience would allow GE engineers to better monitor and measure the progress of a supplier. GE hopes to lower 80 per cent of the present throughput time through using the cellular machining, other advantages including better planning and maintenance. The system is expected to determine when preventive maintenance is required and plan it into the production schedule instead of waiting for a breakdown and having it interrupt the schedule. Key to the system is the control structure that allows scheduling data to be transmitted to the machine tool without intervention instructing the machines on how many parts to produce and when to produce them. (American Metal Market, 21 October 1985)

Flexible cell cuts stock levels from seven weeks to one

SSP Pumps of Eastbourne invested £650,000 during 1985 in CNC equipment - and £500,000 of that bought a Scharmann flexible machining cell (FMC) based on a Soleo 2 horizontal machining centre with rotary table. The price tag included fixturing, tooling and installation. The 180-employee company had experienced a 60 per cent growth in turnover in the last three years, and the FMC was introduced to cope with the increasing workload.

Production director Ian Hill says the machine processes stainless steel pump rotor cases that require varying degrees of customisation. In the past, the unpredictable requirements meant that stocks of six to seven weeks were usual. Today, however, the products are made to order and only one week's stock is held.

The machine is served by eight pallets, a 120-tool magazine and has a 20 kW spindle motor. Because the parts were previously machined on less highly automated CNC machines, spindle power needed to be similar in order to successfully transfer the cutting technology (speeds, feeds, tool geometry/material) to the Scharmann FMC. Hill points out that machining times are no quicker than before, but the degree of automation allows unattended running.

The machine is currently operating an average of 144 hours/week and, depending on workload, Sunday running can be undertaken. Fixturing has an important role in this respect. Manufactured by Bartling Designs of Sittingbourne, each pallet has a fixture cube which can carry 12 components - sufficient for 12 to 16 hours of continuous machining. Two sizes of cube are employed: 350 mm^2 x 700 mm; and 250 mm^2 x 550 mm and fixtured to accommodate about 17 component families.

Each rotor case passes twice through the cell; one for front machining, the other for back machining. Entry and exit ports are not produced at this time.

A man is in full time attendance during the single day shift. He has to load/unload components, pre-set and fit tools, and perform routine maintenance such as filter changing and oil level checks (as indicated by the machine's Siemens control).

While it is possible to de-rate speeds and feeds when the FMC is unattended, Hill says this is not sensible for stainless steel products. Indeed, he says, such action would adversely affect tool life and surface finish if the cutting rate is too low.

Work for the cell is scheduled through materials requirements planning (MRP) techniques. There is no opening and closing of numerous batches: the paperwork associated with such activities for batches of one to 10 would be too costly. So, at the end of each week, all work is closed off and a new MRP schedule is printed for the next week ... Effectively, one week is one long job. (Machinery and Production Engineering, 15 January 1986)

CAD/CAM in the paper industry

From micro-based to mainframe

Turning now to our own industry, most of the initial CAD systems were installed by the larger consulting engineers, since they were best able to utilize them fully and thus justify the considerable investment.

A few large US paper companies did venture into the field, but generally the early problems outweighed the benefits. With the increasing obsolescence of their systems, they abandoned the field to the large engineering consultants that undertook their major capital projects. Today, mill utilization of CAD is mainly at the microcomputer level.

The micro-based systems are the fastest-growing sector, but there are evidently those among our respondents who would prefer to pay somewhat more in order to derive greater benefits. CAD/CAM systems are used by several paper equipment manufacturers. They, like the consulting engineers, have expanded and improved their original systems.

To illustrate the types of systems being used, we shall describe four different scales of system. The smallest is the micro (e.g., personal) computer level. While it is the smallest system that most companies would contemplate (elementary CAD systems do exist for some of the more powerful home computers), the entry cost is low and they sometimes represent the optimum approach.

Autodesk's AutoCAD software, with more than 15,000 users worldwide (counting all applications), is one of the leaders at the microcomputer level. Intended for the mass market, AutoCAD is highly versatile. It can produce block schematics, flowsheets, layouts, architectural designs, mechanical and electrical drawings, designs for forms and cutting patterns. Particularly significant is the introduction in 1985 of a 3-dimensional drafting package, as previously most micro-based systems have been limited to 2-dimensional capability.

AutoCAD runs on most modern micros with the MS-DOS/PC-DOS operating system, requiring not less than 384 KB (kilobytes) of RAM (random access memory) in most cases, although 512 KB is better. It can run on two double-sided double-density 5.25-in. floppy disk drives, but Winchester hard disk storage is preferable.

Graphics output can range from monochrome to high-resolution colour display units. Plotters can be from A4 to A0 in size, and have up to 10 different pens. Input to the system is normally via a mouse, digitising tablet, touch pen or the new CAD/camera.

A facility that allows the transfer of a complete drawing database permits AutoCAD to link up to CAM systems in the preparation of tapes for numerically-controlled machines, or to other CAD systems including some on mainframes. Complementary to AutoCAD are a word processing package and a database, such as dBase III, with the latter permitting drawings to be linked to component listings/bills of material, costings and other calculations. Prices for complete AutoCAD systems, including a multi-pen A3 plotter, start at $8,500.

At the next highest level of installation, we enter the dedicated CAD systems. Here we encounter a relatively new contender: a self-sufficient single-user workstation capable of working with other workstations or larger systems. Typically, it is 16 or 32-bit, with at least 500 K of memory, runs on a Unix operating system and is capable of around 1 MIPS (one million instructions per second). Although relatively new, this intermediate size is being well received by industry generally.

Moving up again in scale, we come to the established realm of minicomputers and superminis. Typically, these have been installed one-at-a-time by the larger industry consulting engineers, permitting them to get into the new technology while at the same time allowing it to mature closer to their requirements. Systems differ essentially in the number of workstations and thus the supporting memory, hard copy and other facilities needed to support them. Such large systems have recourse to a larger data base than either micro-based systems or dedicated workstations used singly.

A good example of such a large-scale CAD system is that used by Jaakko Pöyry Engineering (JP) in its Helsinki office. JP has four Calma systems, installed progressively between 1980 and 1984, with a total of 15 workstations. The two earliest systems are 16-bit machines with 256 K of main memory each, while the later systems are 32-bit with a total of 10 MB of main memory. Disk memory capacity totals 3,500 MB.

Jaakko Pöyry's principal applications are process, electrical, instrument and HVAC diagrams, architectural plans and perspectives, drawings for feasibility study mill layouts and structural elements in buildings. The electrical, instrument and HVAC diagrams are produced automatically overnight. The data is extracted from the material handling and specifications systems on a Hewlett Packard 3000 computer.

Probably the largest CAD/CAM system operating in the paper industry is that of Beloit Corp. in the USA. Beloit's ultimate goal is worldwide integration of drawing data and manufacturing information between its Beloit, Wisconsin, headquarters and all affiliated companies in the USA, England, Canada, Italy and Brazil. ...

The replies to PPI's question regarding the disadvantages of CAD/CAM reflect the many difficulties overcome, particularly by those who pioneered the early large systems. In particular they cited: the high training burden, selling CAD/CAM to old timers, staffing (particularly job mapping among systems personnel), instituting shift work in order to fully utilise the system, their unsuitability for the infrequent user; high up-front cost of selection and installation, rapid obsolescence of hardware and software, costly maintenance and repairs, slow response time, poor system support, poor plotter reliability; space and controlled environment requirements; and, when relocating, the expense and non-availability of data. However, data loss resulting from power failure was not cited as a problem due to the use of magnetic tape back-up and isolation transformers to guard against power fluctuations.

As to the future direction of CAD/CAM, generally, the polarization that has begun due to improvements in hardware will intensify, with the larger systems being used by equipment manufacturers

and consulting engineering companies, while mills and corporate or divisional headquarters will increasingly use micro-based systems. Systems will become more highly integrated, in the sense of local area networks (LANs) between a CPU in the same building, micros linked to headquarters systems and also to those of the company's engineering consultants. Laser disk storage technology, in combination with further improvements such as shorter response time and artificial intelligence, will obviously make the small systems more powerful and independent.

It is probably the rapid pace of technological development that accounts for a surprisingly high proportion of the last paper producing companies being still on the sidelines. However, at the present state-of-the-art, it should generally be possible to justify a multi-tasking micro in the mill engineering department capable of CAD, for such work as small internal engineering jobs, electrical diagrams and updating mill drawings, which can subsequently be tied in with the mill business system.

As for the larger systems, they also have their place. Companies involved in aerospace and large government contracts are expected to make heavy commitments in this technology, and the paper industry should keep informed of such developments. Gradually these large system users will evolve their own form of computer integrated manufacturing. (PPI, January 1986)

Automatic design and production using CAD/CAM

The designers at a metallurgical firm in the area of Bari, Italy have been using CAD/CAM at Tecnopolis Novus Ortus, to design products and to program production by automatic machines. This real-time interactive system integrates automatic design and production, including as well the edition of technical operating and maintenance manuals. The integrated software is administered by the central IBM 3081 and 4341 computers at Tecnopolis.

There are other programs at independent workstations dedicated, for example, only to CAD, which are administered by personal computers. They are not integrated with the other two areas (CAM and electronic printing). The software for independent design is *Autocad*. There are workstations for civil and mechanical engineering, some of which are connected to said central units for designs with certain applications of the third dimension. Graphic terminals with extremely high resolution (1024 x 1024 pixels) may be used, which allow design at any scale, including 1:1 and with 16 colours to identify various parts of the object.

In CAD/CAM structural verifications and material strength are done by systems of high analytic content, which make it possible to study the simulation of automatic production. Once the object has been designed, the same system generates the program for the numeric-control hardware. For example, to manufacture an engine cylinder with a numerically controlled lathe, it produces the program on perforated tape i.e. the simulation of the operations of automatic design and production using CAD/CAM/2 the lathe in action on a semi-processed cylinder on the basis of the drawings.

The final design can be reproduced on the plotter so that a library of standards and symbols is formed, from where the operator can retrieve the design when redesign on a different scale or cancellations or additions become necessary. This results in time and cost savings compared to traditional filing systems for designs drawn on paper for the production of manuals. The database is asked for the filed drawing and the page of the book is composed interactively by adding texts, notes, etc. A page composed in this way is printed on a special support suitable for editing by traditional typographic means. (IBI-Press-Bulletin, No. 69, 24 February 1986)

PCB/CAD in the electronics industry

CAD techniques have lent themselves well to the needs of the electronics industry. The total world CAD market last year was estimated at over $1.7 million, of which electronics will account for close to one fifth, making this sector second only to architects and civil engineers in the use of CAD.

The main use of CAD in electronics is for the layout of Printed Circuit Boards (PCBs). Virtually every electronic product has one or more PCBs. Every PCB layout is derived from an electronic diagram commonly called a schematic. A schematic plus a bill of materials are the information required by a designer to produce a PCB layout.

The quality of the PCB artwork determines the quality of the resulting PCB. In the early 1960s these artworks were produced by drawing the pattern in ink on white card, since this was what was photographically acceptable. A major breakthrough took place in the late 1960s with the use of very accurate self-adhesive black tape and pads which were placed on a sheet of film to represent the desired pattern of interconnects. This method remains with us today but has further improved with the use of different coloured tapes, to represent the different layers of the PCBs.

As the use of electronics grew so did its sophistication. The need for more complicated PCBs grew and manual methods were not capable of dealing with the complexity of the design, or the quality required in the final artwork.

So computer programmes were developed to assist in the design of the PCBs for this ever growing sophisticated technology. One of the most important advantages offered by PCB/CAD was the development of high precision photoplotters to produce the final filmwork. The accuracy and quality of this photoplotted filmwork remains one of the major advantages of designing PCBs using CAD. PCB/CAD was thus used to solve difficult layout problems and produce high quality PCB filmwork.

It has since developed to include computer-aided engineering or CAE. In fact the greatest growth in software at present is in this area. CAE is taking the design process many steps further. It gives an electronic engineer the ability to design his circuit with the assistance of the computer. So the circuit diagram shown in figure 2 (see page 55) can now be designed on the computer and the functions and ability of the circuit to do what is intended, can be tested. The software can be used to simulate logic information and allows the engineer to test the functions of his design without having to build a prototype. It doesn't completely replace the need to build prototypes, but it can, in some instances, exercise a circuit over a wider range of tolerances quicker and easier than by using prototypes.

Integrated Circuit (IC) design

The number of companies involved in designing ICs is much smaller than the number of companies involved in PCB design. However, the design requirements are such that CAD plays even a more important role than with PCBs. Almost without exception all ICs nowadays are designed using sophisticated PCB/CAD equipment.

One major difference between CAD systems used for architectural and mechanical applications and those used for PCB design is the requirement for high precision filmwork. I have already mentioned this briefly above. The filmwork of a PCB layout plays a much more direct role in the manufacture of the PCB than, say, the mechanical drawing of a shaft or gear plays in its final manufacture. So for most architectural and mechanical use, output to high quality pen plotter is nearly always sufficient.

A photoplotter is a very high precision flat-bed plotter, which uses a Tungsten-Halogen or Laser light source in place of the pen. This light source coupled with a wide range of different apertures is used to expose selective areas on photo-sensitive material. The operation takes place in darkroom conditions. Many photoplotters have hoods on them to create their own darkroom conditions.

For most PCB design applications, output to a photoplotter is a must. Although it must be said that the quality of penplotters has improved substantially, so that their quality is sufficient to meet the requirements of simple PCB designs, many of the micro CAD systems available will only output to a penplotter. The vast majority of companies who have PCB/CAD systems would not consider having their own photoplotter as its cost could not be justifying for one PCB/CAD system alone. (Typical costs are £60k upwards). Therefore the trend has been for dedicated photoplotting bureaux to become established to service the needs of many PCB/CAD users.

Photoplotters are also used by civil engineers for the production of Ordnance Survey maps, etc. (Electronics Report [Ireland], March 1986)

SOFTWARE

Japanese programming breakthrough

To reduce the rocketing costs of developing and maintaining software, computer experts the world over have for many years been attempting to teach computers to write their own software. In Tokyo recently, a Japanese researcher, Akifumi Shu, demonstrated in public for the first time a system that he claims is capable of doing this, and more. The system, known as Logical Program Synthesis (LPS), not only generates programs automatically, it also - more important - proves that the programs thus generated contain no errors, therefore need no debugging, testing or maintenance.

Shu says that his system can be applied to developing any kind of software up to and including large, complex programs such as operating systems.

Shu has been developing LPS for more than 15 years. The initial stimulus came from the problems computer scientists at Kyoto Industrial University - where Shu is an associate professor - were experiencing in writing and debugging a very large program - more than 400,000 lines of Fortran code. The program was designed to analyse why oil tankers break up, the source at that time of much national interest, because tankers were then Japan's largest export. The program had to solve huge linear equations to simulate the stresses that occur. But a single bug could bring the whole program grinding to a halt; worse, it could take as much as two years to fix. It was at that point, according to Yoshiaki Uemura, head of the university's computer science department, that they began to contemplate automatic programming.

The approach to automatic programming that Shu has adopted is known as theorem proving. The idea of theorem proving is to define knowledge (such as numbers) as symbols. These symbols can be built into equations that specify a program, for example, a program to control a missile. The next step is to check that these specifications are logically valid - theorem proving. Once the specifications are proven, the system generates lines of code.

Until now, no one has succeeded in generating more than 10 lines of program by theorem proving alone. The most serious problems are that the specifications are more difficult to write than the programs themselves; that existing provers are not sufficiently powerful to generate large programs; and that specifications must be complete, with all symbols defined in advance.

For these reasons, theorem provers have tended to be used in combination with other automatic programming approaches. LPS is the first system which adopts the theorem proving approach alone. It differs from previous theorem provers in allowing specifications to include free variables. The variable can be replaced, once the proof has been generated, by statements written in a procedural language, such as Fortran.

The initial incompleteness of LPS specification means that they are not logical expressions in the true sense. Shu claims that the reason why all symbols do not have to be defined in advance is because of his system which he calls "symbolic formula". Shu says: "This supersedes the classical logical system," which, in turn, "constitutes a theoretical base for future software development".

Shu has yet to clarify exactly what this symbolic formula is. His reluctance to publish details of his work until his theory was complete has led to considerable scepticism in Japan about LPS. One problem is that the only people qualified to evaluate Shu's claims are those with a background in logical programming. Nonetheless, insiders who have seen the system working are impressed.

As yet, LPS has none of the documentation and user manuals necessary to turn it into a commercial product. These will, however, be available in two or three months, promises Ryuichi Otsuka, president of Nippon RAD, the venture company which has backed the development of LPS during the past five years with £0.5 million.

LPS will need more than manuals before it really starts to threaten programmers' jobs. The theory, the most difficult part, is complete. What the system now needs is a way to make it easy to use. Currently, it responds only to specifications written in first order predicate calculus, which only a handful of programmers are capable of writing. (This first appeared in New Scientist, London, 30 January 1986, the weekly review of science and technology)

Profitable projections for Canadian software suppliers

A report published by International Data Corp. (Canada) Limited of Toronto, Ontario maintains that the Canadian software and computer services market will grow to more than $3.8 billion by the end of 1989 from $1.6 billion in 1984.

International Data's director of research said that Canadian-owned companies accounted for 52.4 per cent of the $902 million generated by the leading

25 suppliers in 1984. He added that "it is not inconceivable that Canada could become one of the top five packaged software suppliers in the world" in the near future.

The study examines suppliers of packages, processing services and professional services. Packaged software is the fastest growing segment; processing services, also known as the service bureau industry, have grown slowly and will rise less than 10 per cent annually in the forecast period, the report says.

Consolidation is predicted for many companies, with small software houses merging into or being acquired by other companies in the industry and non-computer companies. (Canadian Reports, Vol. 2, No. 5)

Cost-of-software

And just how do the vendors determine the prices of their software packages? According to a Venture Development Corp. report, there are three critical factors: the size of the potential market, the number of competing packages, and the extent to which a package offers unique benefits.

However it's done, there appears to be a great diversity of pricing between the different categories of packages, comments the Natick, Mass., company in its report, "IBM Personal Computing Software Directory and Analysis".

The big-ticket items, with an average price of $1,378 per package, are those products sold for use on IBM PCs and compatibles designed for specific vertical markets. For example, VDC found packages for such specialized practices as duct sizing, cattle management, roadwork alignment, political campaign management, and chiropractor records management. "While some of these packages is likely to reach best-seller status," says the VDC report, "each appeals to a target market willing to pay a premium for special software."

The price drops abruptly, almost by half, for another set of products that can also be highly specialized: the accounting packages. The standard packages include programs for accounts payable and receivable, general ledger, payroll, and fixed assets reporting.

Also among the more expensive categories on the list is business software relating to investment, financial analysis, decision support, sales and marketing, business administration, and generalized manufacturing functions.

The most popular titles - those packages for database management, communications, spreadsheeting, word processing, and graphics - run in the $200 to $500 range and represent the heart of the PC software industry. At the bottom of the price ladder are educational software packages, designed primarily for home or school. (For average PC software prices see figure 3 on page 55).

The $795 study examines the purchase and use of personal computer software in detail and describes each of the 3,000 packages available for use on IBM PCs and compatibles. (Datamation, 15 February 1986) Reprinted with permission of DATAMATION magazine (c) by Technical Publishing Company, A. Dunn and Bradstreet Company - all rights reserved.

Some specialized software

Oxford Music Processor (OMP) is a computer program developed in the Faculty of Music at the University of Oxford to automate the task of preparing musical scores prior to printing. Hitherto this has been a laborious task requiring specialist skill to adhere to all the rules of musical notation.

Using OMP, a tune is input on a standard alphanumeric keyboard in two sweeps - the first establishes the rhythms and the second pitches each note on its correct line. An accomplished musician can complete each sweep in about the time it takes to play the tune. Four-part music requires eight sweeps.

BTG is funding the adaptation of the software (which was originally written to run on a DEC PDP 11 computer) to run on a personal computer so as to make it affordable to smaller publishers, composers and arrangers, professional music copyists and academic institutions. The software and its associated documentation will be published by Oxford University Press.

A computer-based editing system for conventional text and graphics has also been developed at Oxford in the Oxford University Computing Laboratory to run on a PERQ minicomputer. Called QED, the software is display-oriented and enables the rapid production of high-quality monochrome documentation. BTG has paid for a small amount of consultancy at the University and has licensed the QED software exclusively to Program Products (Marketing) Ltd.

Bradford University Software Services Ltd. (BUSS) was set up with BTG's help as a "campus company" to exploit academic research at the University of Bradford. Its main product is SIMPLEPLOT, a library of computer subroutines that enable FORTRAN programmers to display their results graphically with a minimum of additional programming effort. This has been installed at over 250 sites and is sold through agents in West Germany and Japan. BUSS will be recruiting additional staff and moving to larger premises during 1985.

The WISARD adaptive pattern recognition system developed at Brunel University works on the principle that an object can be identified from its light values at neighbouring points. These light values are stored as digital data in a large number of random-access memory chips as localised key features rather than an overall pattern.

The recognition process begins with a teaching phase during which a television camera is used to acquire data associated with a reference image of a particular object. If this object is liable to variation (as is the case with a signature or a face registering a range of emotions), all likely image variants are input and an "average" description compiled.

Subsequently these reference data are compared very rapidly with those derived from a new, supposedly identical, object by using semiparallel data processing to check several key features simultaneously. If the subject is not within the known range of variability, it is rejected.

The system can be set up to be particularly good at discriminating between objects where little variance is expected. This lends it to tasks such as quality control of banknotes or postage stamps, and the detection of forgeries.

WISARD has been licensed exclusively by BTG to Computer Recognition Systems Ltd., a relatively new Wokingham-based company specialising in image processing equipment for inspection, vision systems, and television frame capture and storage. (British Technology Group (BTG) Review)

A new Gal Friday for Cray's supercomputers

Supercomputers are capable of solving major scientific and engineering problems. But developing programs for giant problems is no small undertaking. Thousands of lines of computer code have to be patiently pieced together over a period of months. Since that is usually done on a multimillion-dollar supercomputer, it can be hideously expensive.

But in mid-March, Scientific Computer Systems Corp. unveiled a so-called minisupercomputer that promises to slash the cost of developing software for supercomputers from Cray Research Inc. SCS's machine is a midget clone of the Cray X-MP, and it will not only run the 200-odd programs developed for the X-MP but also can be used to write new software. The Wilsonville (Ore.) startup's machine costs $600,000 and up, about 10 per cent as much as the Cray, yet it has 25 per cent of the big number-cruncher's prowess.

John T. Lynch, president of Venture Consultants Inc. and former director of technology for Burroughs Corp., is so impressed he plans to propose that the National Science Foundation buy SCS computers for the dozens of companies and universities participating in the NSF's six new supercomputing centres. If researchers develop programs on SCS computers, the Crays would be freed for the real work: solving problems. (Reprinted from the 24 March 1986 issue of Business Week, (c) 1986 by McGraw-Hill, Inc.)

Eyeball-to-eyeball

It is going to be eyeball-to-eyeball for medical students. A new software program in the form of an interactive video disc has been produced by Microscope, the Berkshire-based company and the first teaching disc will contain a detailed map of the eyeball. It is part of a range of teaching aids which will provide a complete map of the body. About 50 hours of programming, filmed partly at the Royal College of Surgeons in London, will be available. (Financial Times)

IBM emphasises software production

Software has become the key to the future survival of computer firms and the catalyst for increased hardware sales. The industry is overwhelmed with innovative hardware. Software, however, continues to lag behind.

The present slump in computer business has been blamed on the lack of appropriate software with which to integrate PCs with mainframes and minis.

A lack of third-party software has hurt growth of the "Bunch" (Burroughs, Univac - now Sperry, NCR, CDC and Honeywell).

Technical Publishing Company, in its 1984 user survey, provided the estimates for US markets for software designed for mainframes, minis and PC/micros.

Markets for all three classes are expected to grow rapidly through 1988 and beyond. If the PC/micro and mainframe software markets continue to grow at 55 per cent and 23 per cent respectively after 1988, the PC/micro software will surpass mainframe software market by 1991. For the balance of the 1990s, however, mainframe software, which is the focus of this report, will be the leader.

IBM generated $3.2 billion in software revenues in 1984 ($1.7 billion in the US and $1.5 billion abroad), and about $4.2 billion in 1985 - a 30 per cent increase. The bulk came from mainframe software, primarily operating systems, database management systems, productivity tools, and industry applications. The company's US revenues accounted for roughly 17.5 per cent of the total US software market in 1984.

IBM's goal is to increase overall software revenues by 35 per cent per year, higher than the forecasted market growth rate, and gain market share in both the US and Europe. If this succeeded, IBM's revenues from software alone would reach $19.4 billion by 1990.

IBM's dominance (75 per cent to 80 per cent) of the large-scale mainframe market has established MVS and VM as the de facto standard operating systems. Software houses have adapted MVS and VM as the bases for their products, and created a huge selection of application alternatives for MVS and VM users.

This infrastructure encompassing MVS and VM has seriously impaired the ability of the Bunch firms to gain market share, and has dissuaded IBM plug compatible machine firms from developing and actively promoting alternatives to MVS and VM.

The high costs entailed in developing and maintaining an operating system have also discouraged software houses and computer firms from pursuing alternatives to MVS and VM. IBM has spent billions of dollars to develop and maintain those operating systems.

IBM's investments are, however, paying handsomely. With over 20,000 copies now installed worldwide, and the number climbing, MVS and VM licence fees are now generating an estimated $1.5 billion per year in recurring revenues. (Computer Weekly, 27 March 1986)

Cost of computer translations goes up

Europe's Council of Ministers is being pressed to spend an extra £6 million on a European Community translation project called Eurotra. The extra cash is needed to enable Spanish and Portuguese to be added to a roster of seven languages for which the computer system is currently being designed. Eurotra, which will automate the translation of a large percentage of the 0.5 million documents handled by Community translators each year, is being built to handle 42 language pairs. When Spain and Portugal join the European Community, the number of pairs of languages required will go up to 72.

The project involves teams of linguists and computer scientists at 11 European universities. It began in 1982 with a total budget of some £16 million, made up of contributions from the Community and individual national governments. Teams at the University of Manchester Institute of Science and Technology (UMIST) and Essex University are responsible for the British contribution. Eurotra is due for completion in 1988, but the inclusion of Spanish and Portuguese will put the project back 18 months, according to its head, Sergei Perschke.

At present, most of the research is concentrated on producing an intermediate representation of each language that will enable it to be translated into the intermediate version of each of the other seven languages. By the end of next year, researchers hope to demonstrate a prototype system with a vocabulary of 2,500 words that can translate a 150 page document describing the Esprit information technology research programme. The Esprit document was chosen because it is a good example of the different styles of writing used by the European Commission, and because researchers are familiar with its subject.

The Eurotra project team will shortly be calling for tenders from commercial companies for the development of software for the system. Five international consortia are in the running at the moment. The Eurotra system will be designed to work with AT&T's widely used Unix operating system (housekeeping program) to enable it to be mounted on as wide a variety of hardware as possible.

The European Commission already operates an older machine translation system called Systran which has three language pairs: English-French, French-English and English-Italian. Some 12,000 pages pass through Systran keyboards each year. Translators working with the Systran system can improve their work rate from seven pages per day to between 20 and 25. Eurotra would increase the number of pages a translator can get through each day beyond 25 towards a theoretical maximum of 50 pages.

Eurotra will be operated in the same way as Systran. Translators will key in their work through a terminal and be presented with a first draft of the machine's translation which they can then edit into a finished version on screen.

The difference between the Eurotra and Systran systems will lie in the number of languages on each and on the accuracy of the translations. Many more of the ambiguities of language will be catered for in Eurotra.

Eurotra, by far and away the most ambitious machine-translation project in the world, will be exploited commercially. The Commission expects it to be used by companies to translate customs documents, manuals and other written material. (This first appeared in New Scientist, London, 7 November 1985, the weekly review of science and technology)

Making sure software sales aren't lost in translation

It's not easy getting hold of native-language software in Arab countries where few people use computers. Few software companies will bother translating their programs for the minuscule sales. But now, Unique Computers International Ltd. of Tualatin, Ore., sells a $300,000 bilingual system that can translate almost any off-the-shelf software package - and the data it contains - into Arabic. Says Sam Habib, Unique's technical director, who took eight years to develop the system: "I wrote a system that uses any software that's out there."

Unique's system, a central computer that serves up to eight terminals, has special software in it that can translate 10 popular programs with just the touch of a button. Then, to run other software, customers can build on the system's central software and add instructions for translating other commands and important words not in the 10 initial programs. This is no job for the uninitiated. But it is much cheaper and faster than starting new programs from scratch, claims Habib. Coming soon: a version for German. (Reprinted from the 21 October 1985 issue of Business Week, (c) 1985 by McGraw-Hill, Inc.)

Chip-design gets the boost

Five systems houses have won contracts worth £4.5 million from the University Grants Committee - in a nationwide initiative to boost teaching and research in microelectronics design. The bulk licensing deal covers software worth about £25 million on the commercial market, and will enable students to design and test chips.

The initiative comes in response to calls from 45 universities, including Cambridge, Edinburgh and Strathclyde. They are keen to add or develop undergraduate courses in integrated circuit design. All systems will be in place for courses to begin in October: polytechnics are expected to follow suit.

The five companies - Silicon Microsystems, Racal-Redac, Cambridge Science Park start-up Qudos, and US suppliers Conrad and Silver-Lisco - agree that the UK needs the investment to train the silicon designers of tomorrow.

Professor Erik Dagless of Bristol University, a member of the university working party that put the proposal to the grants committee and evaluated the software tools, describes the initiative as "the biggest co-ordinated step in the teaching of integrated circuit design anywhere in the world".

Students will use software tools that are used in industry; the software will be supported through lead sites. The supplies will also keep them abreast of new developments. (Computer Weekly, 13 February 1986)

AI - EXPERT SYSTEMS

AI language to emulate thinking processes

Revelations Research Ltd. and Logicware Inc., the Toronto-based developer and distributor of the artificial intelligence language MPROLOG, have formed a collaborative venture to develop an AI language that will emulate the thinking processes of the human brain. According to the vendors, it will be the first AI language designed for vector processing by a supercomputer.

RRL is the new company formed to research and develop a series of "superchips" intended to simulate certain operating segments of the human brain's neural network.

The first step in the process, already under way, is to develop a special version of MPROLOG designed to run on the Control Data Cyber 205, an 800MIPS computer. The 205 will work in conjunction with a Cyber 170. Both machines are installed at RRL's Mississauga headquarters. The 170 will provide the data processing structure and will be used to develop the software that will "tutor" the 205.

According to RRL president William Madryga, "one computer will 'teach' the other." The Cyber 170 will be fed information that it will store, process, and pass on to the Cyber 205 in an appropriate manner. When necessary, the 205 will seek clarification from the 170 until it has full information in the proper format.

Madryga contrasts RRL's efforts with the serial operation of the von Neumann architecture. RRL's goal is to come closer to the operation of the human brain, which uses a "kind of roving, arbitrary, but highly selective, series of judgments with the speed of light".

The research is designed to produce a processor - not necessarily a computer in the sense we use the word today - with thousands of memory cells. "Each cell will be a rudimentary processor that will allow a high level of parallelism," says Madryga. "Each of the cells will be capable of acting simultaneously with some or all of the other cells.

"RRL will be working toward a system within which a computer will be able to alter, expand, or reduce its programming processes based entirely on its own experience while operating," he says. "It will be a different kind of 'judgment' perhaps, but we are, in fact, contemplating a machine capable of exercising judgment." (Reprinted with permission of DATAMATION magazine, (c) by Technical Publishing Company, A. Dunn and Bradstreet Company, - all rights reserved.)

THE TIMES TUESDAY DECEMBER 3 1985

Bell Labs puts a big brain on a little chip

Researchers at AT&T Bell Laboratories have taken the next logical step in artificial intelligence: building an expert-system-on-a-chip. This micro-expert is similar to a computer's microprocessor "brain", only it has 16 rules of thumb for reaching a decision wired into its circuitry. Putting these logical rules on the chip rather than in software - the usual approach - produces amazing speed. The chip can zip through 80,000 logic inferences a second. That's roughly 10,000 times faster than most conventional software-based expert systems.

The trouble with "hard-wired" logic is that it could restrict the chip to very narrow applications, since the number of rules is small. Expert-system programs often contain hundreds of rules. Bell Labs got around this limitation by using so-called fuzzy logic, a technique that doesn't require data inputs to be stated with the usual black-or-white digital precision. Instead, the chip can handle imprecise qualifiers such as "improbable", "possible", and "highly probable".

Likely applications range from controlling factory robots to guiding military missiles. For even more demanding chores, Bell Labs is now working on a micro-expert that will have 250 embedded fuzzy-logic rules. No decision has been reached yet on whether the chips will be offered commercially. (Reprinted from the 13 January 1986 issue of Business Week, (c) 1986 by McGraw-Hill, Inc.)

Development of AI

The world's leading manufacturer, Texas Instruments (TI), has started intensive research and development work on artificial intelligence (AI) for the next generation computer. The company has 10 per cent of Carnegie's stocks and provides research and development funds for three years to secure an exclusive right to sell AI products in a joint development project with Carnegie. Carnegie was established by four scientists of Carnegie Mellon University. They started research for AI two years ago. They developed an expert system on the world's highest level for management and productivity improvement.

Meanwhile, TI and Sperry started joint efforts for AI product development and sales. Sperry has constructed an "intelligent system center" at Minneapolis, Minnesota, investing 200 billion dollars for research and development of AI jointly with TI.

Both companies strengthen ties for selling the Explorer. The Explorer is a new type of computer developed by TI on the basis of technologies from MIT and other technological institutions, and is claimed to be a powerful tool for the development of the AI system.

The basic system operates on LISP, a high level program language developed by MIT's AI group. (Chemical, Economic and Engineering Review, November 1985)

Expert system makes it easy to fix instruments

Every year, Lockheed Missiles and Space Co. must calibrate and repair some 55,000 of its electronic instruments. To automate this staggering task, the giant defense contractor has adapted a "generic" expert system to perform diagnostics in a way that mimics a human technician. In this way, a human can more easily figure out where the system went wrong when it can't come up with an answer, says Lockheed engineer Michael P. Prevost.

The generic system - LES, for Lockheed Expert System - is written in Ada and consists of a set of data structures that may be used for attributes of both the system under test and the control system that determined which tests to make. Having such easy access to the control system enables LES to change its goals on the fly after receiving new information or starting a new test. It is this flexibility that gives the system its human-like quality.

Prevost and Thomas J. Laffey of Lockheed's Palo Alto research laboratory have put LES to work on a Hewlett-Packard Co. 6130C digital voltage source.

With a knowledge base that includes information on the 6130C's operation, LES has correctly diagnosed faults that were deliberately planted for testing purposes.

The HP 6130C contains 9 circuit boards, 39 circuits, and some 300 components. Rather than test each of these according to a preset routine, LES uses two kinds of heuristic rules. An If-Then set embodies knowledge about specific faults in the voltage source. When-Then rules determine which faults to look for. LES personifies the latter rules as a "demon" that runs the system by setting priorities.

The demon comes alive when certain events occur, such as the isolation of a fault to a particular board or the discovery of an out-of-tolerance value. The When rules then reset the priorities of the If-rule sets. Several If-rule sets may be operating at one time, with a separate decision tree for each goal, but the priorities may differ. If a board-level test seems to point directly at a certain component, the demon can bypass the circuit level, just as a technician would, and put highest priority on testing that particular component.

LES, possibly the first expert system written in Ada, runs on a Digital Equipment Corp. VAX-11/780 (Lockheed will switch to a MicroVAX next spring). Ada is slower than LES's initial implementation in PL-1, says Walter Perkins, one of the system's designers. Ada does provide a good maintenance environment with many checking procedures, however. That's very useful in a large program, Perkins says.

Lockheed has now applied LES to nearly 20 projects, including fault diagnosis in a signal-switching system and rule checking for computer-aided design. The instrumentation diagnostics tested well on simulated faults. Prevost says he will not be satisfied, however, until they are field-tested. That may take some time because the 6130Cs don't often fail.

The next step for Lockheed will be to generalize the processes used in diagnosing the 6130C across a broad range of instrumentation. One of the purposes of the first experiment, Prevost says, was to see how much of an existing knowledge base can be preserved and to determine which rules are general and which specific. First indications are that instruments behave pretty much the same at the circuit level and below, where an amplifier is an amplifier and a transistor is a transistor. At the board level and above, Prevost says, systems tend to be unique. (Electronics, 23 December 1985)

AI to help mechanics at Renault do a better job

French automobile owners might soon get faster and more expert repair work, thanks to a move by the country's principal automaker to put an artificial intelligence system at the service of its mechanics.

The heart of the system is an expert-system software module dedicated to diagnosing the cause of automobile malfunctions. The system was jointly developed by Cap Sogeti Innovation, the research subsidiary of Cap Gemini Sogeti SA, France's largest data-processing service and consulting group, and Régie Renault, the nationalized car maker.

The software comes in a shell program that can be customized by automobile technical experts to deal individually with any of a car's various subsystems. The prototype of the software runs on an IBM Corp. Personal Computer and currently is being used to analyse automatic-transmission breakdowns. In the future, it will be used to aid repairs in other areas that are typically difficult to diagnose, such as on-the-road behaviour and electrical faults.

Distribution potential is broad: Renault has some 9,000 dealers scattered throughout France. The initial results of the system's trials have been "extremely impressive," says Gérard Martineau, who is co-ordinating the project from the Renault research centre. Company estimates put the system's ability to solve transmission faults above 99 per cent. (Reprinted from Electronics Week, 16 December 1985, (c) 1985, McGraw Hill Inc., all rights reserved)

Expert systems for engineering applications

Many engineering problems are not amenable to purely algorithmic solutions. As Koen (1) put it, "The engineering method is the use of heuristics to cause the best change in a poorly understood situation within the available resources." To deal with these ill-structured problems, an engineer relies on his own judgment and experience.

Knowledge-based expert systems provide a programming methodology for solving ill-structured engineering problems. Since these systems also provide a flexible software development methodology - by separating the knowledge base from the inference mechanism - they are of increasing interest to the engineering community. (2)

The kind of problems that engineers face in their day-to-day work can be bounded by the derivation-formation spectrum. In derivation problems, the problem conditions are specified as parts of a solution description. A finite set of possible outcomes exists in the knowledge base, and the knowledge base is used to complete the solution. Essentially, solving these problems means identifying the solution path. In formation problems, conditions are given as properties the solution must satisfy as a whole. Most real-life problems fall between these two categories.

Derivation. Engineers normally encounter the following problems at the derivation end of the spectrum: 3

Interpretation. The given data are analysed to determine their meaning. The data are often unreliable, erroneous, or extraneous.

Diagnosis. Identification of a problem area or a fault is based on potentially noisy data. The diagnostician must be able to relate the symptoms to the appropriate fault.

Repair. The faults in the systems are identified, and remedial actions are suggested. Fault diagnosis is the first step in this process.

Monitoring. Signals are continuously interpreted, and alarms are set whenever required.

Simulation. A model of the system is created, and the outputs for a set of inputs are observed.

Control. The data (from sensors) are interpreted, and any deviations from the normal are corrected.

Formation. Typical problems encountered at the formation end of the spectrum are:

Planning. A program of actions is set up to achieve certain goals. The actions should not require excessive resources or violate legitimate constraints.

Design. Systems or objects that satisfy particular requirements are configured. This involves satisfying constraints from a variety of sources.

There are several important differences between the traditional software-engineering development cycle and the cycle for knowledge-based expert systems. (Waterman (4) provides an excellent treatment of the latter.)

Most software engineering projects assume that the problem is one of implementation rather than design. The rigid specifications and modularization imposed are no longer helpful for projects using knowledge-based engineering systems. There, the project should be thought of as a design problem rather than an implementation issue. (5)

Functional specifications cannot be accurately detailed with expert systems. They change as a wider body of test cases and field problems are covered by the system's behaviour. For example, in the development of a system for automating design, the client may not be able to fully specify his needs, which are more like aspirations than specifications.

Domain experts are seldom skilled in knowledge engineering techniques. Hence, continuing interaction with a knowledge engineer is needed until the system has been developed to a nearly final state - that is, until the fine-tuning stage is reached.

The style of program implementation and development is different for expert systems, which are grown incrementally rather than programmed. The program is interactive by nature, and new knowledge units are formulated as the expert uses the program and applies it to new test cases. This contrasts with simply implementing code to meet a functional specification prepared in advance of the implementation.

Knowledge engineering tools are rarely exactly suited to a particular engineering problem. More often, they require adaptation and evolve during the knowledge acquisition and implementation process. Engineering problems are inherently diverse and will continue to pose challenges to the builders of such tools.

Higher level program strategies, such as interfaces and interactions among modules, are often represented in the same formalism as the knowledge base. Thus, these aspects of the program also grow gradually and interactively as the program evolves to handle more and more test cases. Exploratory programming environments seem appropriate for these tasks. ...

Following the four articles is a special section on research in knowledge-based engineering systems. It reports work in progress at 13 universities and research centres. Included are projects in fault diagnosis, expert interfaces, structural design, mechanical engineering, electrical engineering, geographic databases, error recovery in robot control and more.

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Grains of good advice?

Advanced technology is becoming a marketing tool in one of the UK's oldest industries - agriculture. Farmers buying ICI's agrochemicals now get access to an expert system on the use of fungicides for wheatcrops.

For ICI, which claims the service is a world first, the commercial advantage is clearcut - an edge over its competitors. For farmers, use of expert systems may soon become a trend, as they face a mass of decisions on crops and slimmer profit margins.

The expert system, Wheat Counsellor, was introduced in autumn 1984, and is the first in what ICI hopes will be a series of applications for the arable farming community, covering a number of different crops. It is available to farmers on viewdata sets installed at ICI dealers who already use them to provide for advanced management systems.

In use, Wheat Counsellor begins by asking for the particular farmer, farm and the specific field to be analysed. Information is then retrieved from ICI's database about the field's geochemical and farming history, and the type of wheat grown in it. The farmer can be asked for further information about seeds and fertiliser being used, and how they are being applied. The risks from various strains of disease are then evaluated, and explained to the farmer.

Treatment recommendations are made, and along with them cost/benefit analyses for the recommended course of action, or for alternative treatments. This last point is the crucial one - if the system's decision can be justified in hard cash terms, then technological niceties can be forgotten.

ICI has been involved in expert systems research for five years. It took about 12 months to develop, using the Savoir expert system shell developed by software house Isis. Recently, a videodisc facility has been linked into the system. This can elaborate on information presented on videotex, by supplying extra information and high resolution graphics for diagrams/pictures.

Before starting work on Counsellor, the team looked carefully at the advantages of using an expert system. They came up with these key points.

Ease of expressing knowledge: The data in the system is stored in a form more akin to ordinary English than in conventional systems.

Flexibility of expression: The sources of data for the system can range from text-book definitions of fungi to farmers' folklore.

Explanation of reasoning: Expert systems, in addition to arriving at an answer, can explain how it got there.

Creating user confidence is a major part of selling an expert system. Justifying its answers in a way the farmer can follow, and agree with, is crucial to doing this.

The fourth key consideration in favour of the expert system is its ability to handle uncertainty and 'reason' a best result. Treatment recommendations are made, and along with them, cost/benefit analyses for the advice or for alternative treatments - a crucial final stage.

One area ICI did not have to worry about was persuading farmers to use new technology. Mark Rogers, head of ICI's Decision Support Systems Group, said that computers are now a common sight on farms. Young farmers going to agricultural college are trained in the applications of computers in business and return to the industry armed with lots of new ideas.

A number of companies already specialise in management and finance software for the farming community and ICI has a unit devoted to this area - Agricultural Information Technology (AIT). AIT's main efforts are concentrated on Adviser, a viewdata service that farmers can access from terminals in their own home.

The system can act as an information service for weather forecasts, prices and so on. It can also download programs for accounting, stock control and tax returns. In the long run, ICI's plan is to extend the use of expert systems by giving farmers home terminals to interrogate ICI's mainframe computer. The mainframe will have data files on individual farmers and will be able to relate those to its own main data files, offering an informed "opinion" on the user's problems. Rogers said the next step would be to aim for more software integration between systems running on the central mainframe. (Computing, The Magazine, 5 December 1985)

COUNTRY REPORTS

Africa: From assembly to production for export

The Southern African Development Co-ordination Conference (SADCC) has given the green light to a study project for the establishment in Africa of factories for the local manufacture of telecommunication apparatus. Activities in this sector are at present limited, except for sporadic cases, to assembly. According to the experts, the quantity of the equipment produced in African countries, with reference to total installations, does not exceed five.

The intention is to correct this state of affairs by means of the aforesaid project, financed by the Commonwealth Secretariat, by introducing the training of local personnel and the maintenance and operation of factories in order to arrive at the manufacture of a number of components of the final product.

A number of African countries are already introducing clauses into contracts for the supply of material for telecommunications which call for technology transfer into the country. Kenya was among the first countries to implement this type of agreement.

An important Swedish telecommunications firm has established a factory in that country for the assembly and domestic production of material that can be utilised in manual control panels for exchanges. Part of the technical personnel has already been sent to Sweden for training, while the presence of one specialist from the Swedish firm has been assured for assistance during the project's first stage, which is to cost around US$500,000.

Also Zimbabwe, thanks to an agreement between a local company and a Yugoslav firm, which is making constant provision for technical assistance and the training of senior operatives, has reached a good qualitative and quantitative level as far as technical infrastructures and skilled manpower are concerned. The profits produced by the activities of the affiliated companies are totally reinvested in research and development to improve the country's production.

The final aim of the SADCC project, once the first phase of the development of local production has been completed, is to export. Exported products are expected to be destined principally to a market made up of African countries which, by means of trade agreements based on principles of reciprocity through the application of reduced customs tariffs and simplified currency transactions, is to favour the greater exchange of products. (IBIPRESS Bulletin, 3 February 1986)

Canada: Canadian-Japanese research agreement

The Canadian Society for Fifth-Generation Research has signed an agreement to exchange scientific, mathematical, and engineering information with the Tokyo-based institute for New Generation Computer Technology (ICOT). "This will be the first agreement ICOT will have consummated with a foreign organisation," said Peter Eggleton, a science and technology counsellor at the Canadian embassy in Tokyo. (Canadian Reports, Vol.2, No.5)

China: China moves ahead

China has achieved major success in its burgeoning electronics industry - but the country's electronic products are not competitive and there is still a big gap between Chinese and foreign product quality, according to electronics industry minister Li Tieying. Announcing details of a development plan for Chinese electronics in the next five years, Li Tieying said that the proportion of electronics products used for technological transformation in the national economy was small.

China's ability to absorb foreign advanced technology and develop the electronics sector independently was limited. There was a serious shortage of trained people - both in quality and quantity and R&D funds were limited.

The minister then detailed China's plan of attack on these problems. Trained people and funds will be concentrated in a few modern research centres and experimental units. Priority will be given to five major technologies: computers, integrated semiconductors, electronics for telecommunications and industry and modern military electronics. Efforts will be made to narrow the gap between the best levels of Chinese electronics industry performance and standards and world levels.

Li Tieying said that by 1990 the total output value of the electronics industry would make up about four per cent of GDP - increasing at an annual average rate of about 16 per cent. The minister said that China would try to raise electronics product quality by 1990 to the level achieved by foreign products at the start of the 1980s. (Electronics Weekly, 5 March 1986)

Chinese word processing takes a great leap forward

Creating a Chinese language word processing system - a prerequisite for big sales of information-processing equipment in Asia - has been a

daunting task for Western companies. But Intech Systems Inc. of Minneapolis has a new approach that it claims is easier and faster than current ones.

To write Chinese on conventional computers, operators must electronically construct the 5,000 characters in the modern language. They create a character by keying in a long series of symbols and commands, a tedious process that requires intensive training.

Intech uses a phonetic system that lets the operator create the right character by putting together the combination of Roman characters that approximate the sound of the desired word. Using a touch-sensitive computer display, an operator first touches the spot on the screen showing the Roman letter with which the sound of the Chinese word begins. Then a new screen appears, showing as many as 39 syllables starting with that letter. A third screen offers a choice of inflections, making it possible to find the Chinese character for a one-syllable word in only three steps. Intech developed its technology over the past five years for computers used in education, among other markets. The company, which sells the system with a printer for $5,000, already has a distribution pact with China. (Business Week, 3 February 1986) (Reprinted from the 3 February 1986 issue of Business Week, (c) 1986 by McGraw-Hill, Inc.)

EEC News

Esprit maps out 1986 plan

Software technology, office systems and micro-electronic research head a list of projects that will seek funding in phase II of the Esprit programme. The future direction of this European pre-competitive research is mapped out in the 1986 work programme for Esprit. But the programme is already virtually exhausted of cash. The programme is to be revised in the light of progress within Europe and elsewhere in the world.

The man-machine interface and four projects on designing office languages and procedures are already set for the office systems part of phase II when the European Commission has persuaded governments to put up more cash.

The Commission wants a number of small demonstrator projects together with a limited number of large projects in industrial software. (Computing The Newspaper, 5 December 1985)

Esprit opening for non-EEC members

Esprit II is to open its doors to non-EEC countries. According to Horst Ruenke of the IT Task Force in Brussels, the Commission is very much in favour of allowing European Free Trade Association (EFTA) countries to take part in Phase II projects, but on an unfunded basis. The EFTA countries however, would have no say in the Esprit decision-making process. Ruenke said that the participation of the US and Japan would not be considered.

EFTA countries, which include Austria, Switzerland, Sweden, Norway, Finland and Turkey, already have some Esprit involvement on a small sub-contracting level and are fully involved in the more recent Eureka initiative.

Ruenke also said that although Esprit II would stick to its pre-competitive ethic, more emphasis would be put on prototyping proposals and on Technology Integration Projects (TIPs) rather like the Alvey large-scale demonstrators. Further emphasis will be put on small to medium companies, first-time participants, and on the increase technology transfer between companies of different sizes and of different disciplines.

Ruenke said that 665 million ECUs had already been allocated for 1983/84 and 1985 projects, with the rest of the budget being taken by staffing and other overheads. "The 70 million is what we consider is safe to assume won't be consumed by existing projects. Further calls will only be made if the current contracts terminate early or under budget," he said.

The Commission has also decided to make some funds available for the inclusion of Spain and Portugal in the current Esprit efforts. But Ruenke stressed that this is money for existing projects that open their doors to the two newcomers, rather than money set aside for the countries per se. (Electronics Weekly, 19 February 1986)

EEC calls for Esprit research partners

The European Commission is calling for companies to participate in Esprit research projects.

The Commission will hold a proposer's day on 29 April, in Brussels to brief potential proposers on the contents of the 1986 programme. It will enable attendees to familiarise themselves with the way in which projects are undertaken by Esprit. It will also assist them in finding suitable partners with similar research interests. (Electronics Weekly, 19 March 1986)

Small companies win EEC support

Small- and medium-sized innovative technological companies were given a boost when the European Commission made them its top priority for the next three years. Able Matutes, a junior Spanish commissioner, was appointed to spearhead this Commission portfolio after Spain and Portugal joined the European Community on January 1, 1986. His brief is to ensure that such companies have access to financial markets. ...

Jacques Delors, president of the Commission, also floated the ambitious idea for innovative high technology companies of "a whole gamut of financial instruments, to finance technology all the way through". (Computing The Newspaper, 16 January 1986)

EEC doubles R&D cash

The European Commission is planning to double its research and development budget, with over half the money going to information technology and telecommunications programmes.

It wants the 12 member states to fund the new programme, starting in 1987, which will be spending ECU (European currency unit) 9 billion (£6 billion) by 1991. The present four-year scheme, running from 1984 to 1987, is worth ECU 3.75 billion. ... (Computer Weekly, 13 March 1986)

EEC launches education race

The European Commission is about to launch a major initiative to harness microcomputer and software developments in a pan-European education technology programme. The programme, called Delta (developing European learning through technological advance), will develop along the lines of the European telecommunications programme Race (research and development in advanced communication technologies for Europe), and provide a forum for discussion and consultation.

The initiative is born of the Commission's concern that Europe will fall behind its US and Japanese competitors in the development of open learning systems. Its objective is to develop a standard low-cost educational workstation, courseware and authoring systems with full international data aimed at communicating backup, making vocational training accessible to the whole European community. If costs come down sufficiently, the programme could be extended to schools.

Developers will be able to plug their education and training systems into a telecommunications network, called Soft (satellite based open facility for testing). ...

The programme will also include fundamental research and development in the application of artificial intelligence to education. (Computer Weekly, 6 February 1986)

Europe steps up supercomputer race

European efforts to catch up in the supercomputer race with the US and Japan have taken two big steps.

On the continent, Bull and Siemens are finalizing an agreement to build a supercomputer together; and in the UK the Ministry of Defence has emerged as the prime contractor in a three-year, £6.5 million Esprit project aiming to use Inmos's transputer to create a supercomputer at a fortieth of the usual cost.

French state-owned Bull company and Siemens both hope that Eureka, the French-initiated non-defence research programme, will provide much of the finance - between £70 million and £140 million - for the work.

According to F. Lorentz, Bull's managing director, European research centres are being kept out of work in strategic sectors such as meteorology and the space and chemical industries. He quotes the case of two US laboratories which beat European rivals in discovering a new anti-influenza vaccine by using a Control Data machine able to reconstitute the design of certain molecules.

Funding was agreed in August for the supercomputer project. It will use transputers linked together to form "nodes", which will then be interlinked to form "supernodes", and thus a supercomputer capable of 500 million floating point operations per second. (Computer Weekly, 6 February 1986)

Europe banks on new technology

The European banking community is convinced that new technology offers competitive advantages, according to a survey by international management consultancy Arthur Andersen.

The survey of 600 senior bankers says that by 1990 over 50 per cent of the banks' personal customers will use automated teller machines (ATMs), and that by 1995 the same percentage of customers will use point of sale (PoS) terminals. It also predicts that up to 25 per cent of PoS networks will be owned by retailers.

Together with a wider ownership and sharing of networks, the banks predict that national networks will increasingly be linked to provide a European electronic banking service.

The survey says that technology will "be used as a tool to improve or create new banking products and services", rather than to diversify into non-banking related businesses.

The banks believe that any diversification into telecommunications will be unprofitable in the next 10 years, but many see information services as a profitable area of new business. (Computer Weekly, 13 February 1986)

India: Control Data to sell India $500 million of computers

India agreed to buy $500 million worth of computers from Control Data Corp. Under a letter of agreement with the Minneapolis-based company, India initially will purchase about 30 Cyber 810 and 830 model computers, and it subsequently will buy parts to assemble more of the computers in its own facilities, US officials said. They estimated that the agreement potentially could produce $2 billion in direct or related business for Control Data. The officials expect the contract to be signed within a few weeks.

In the first phase of the purchase, valued at $27 million, India will receive a $7 million grant from the US Agency for International Development and a $20 million loan from the Export-Import Bank.

The contract would be for about eight years, a source said. Initially, the Indians would come to the US and train with Control Data, but later they would return to India and build their own computer plants.

The Indian government also wants to purchase two powerful "supercomputers" from the US. It wants the computers, which cost more than $20 million each, for such complex tasks as analysing the effects of monsoons on soil conditions. ... (The Wall Street Journal, 10 February 1986)

Norsk Data to supply India with computer expertise

A Norwegian company has won an $11 million contract to supply technology to India's computer-manufacturing industry, beating out two US competitors. Norsk Data AS will provide the government-owned Electronics Corp. of India Ltd. with the know-how to manufacture "superminicomputers", small general-purpose computers that currently aren't made in India. The 32-bit superminicomputer often is as powerful as many larger, general-purpose mainframe computers and has become popular in India, especially for scientific use. In addition to providing technology, Norsk Data will sell ECIL at least 75 superminicomputers in the next two years. The technology transfer will cost ECIL about 36 million Norwegian kroner ($4.7 million). The entire package is valued at more than $11 million. ...

The agreement was timed to coincide with the opening in Calcutta of India's annual computer show. The project is the first significant government action to enable Indian companies to produce large, state-of-the-art computers. ... (Wall Street Journal, 24 January 1986)

Curry and chips

India will join the exclusive club of high-purity silicon producers when a 25-tonne a year plant based on a domestically developed process begins commercial production soon. Hatkem Silicon, the private firm which runs the plant, claims it can produce ultra-pure electronic-grade silicon in sufficient quantities to meet India's needs. The government will have to evaluate Hatkem's claim before deciding if it should pursue its stalled plan for a National Silicon Facility (NSF) in the state sector, using imported technology.

Hatkem is a wholly owned subsidiary of Hattur Chemicals, which began research on silicon 15 years ago and later worked with the country's premier

laboratory, the Indian Institute of Science in Bangalore. The basic process was developed at the institute, while engineering and development came from the firm. A pilot-scale project set up at Mettur in 1982 was hampered by power shortages for two years.

In October 1984, polysilicon from Mettur passed a test programme at a US laboratory. But in the meantime, the Department of Electronics (DoE) had completed negotiations with the US firm, Hemlock Semiconductors for transfer of technology for a 200-tonne-a-year plant to be located at Baroda as the MSF at a cost of Rs920 million (US$6.3 million). This deal was criticised as a case of obsolete technology being imported at a high price - while local technology already existed. Critics also said the necessary capacity could be set up for Rs300 million and the Metkem product would be cheaper than the Rs1,100 a kg indicated by Hemlock.

Prime Minister Rajiv Gandhi intervened to have the Hemlock deal frozen for a year, so that Metkem could prove its capability. Metkem is going into production well within the March 1986 deadline.

The product has found acceptance with several public-sector undertakings. Bharat Electronics, which has already set up its space division, will use it to make space-quality solar cells for use on satellites. Bharat Heavy Electricals will use the silicon for solar panels, under an ambitious government-sponsored plan for alternative energy sources.

Metkem claims that the purity of its product has been established beyond doubt - one part per billion of boron and 0.5 part of phosphorous. The process uses a route most suited to India's climate, tetrachloride and hydrogen being the starting raw materials. The plant was indigenously designed and installed in seven months. It is modular in construction and additional capacity can be created at minimum cost and without delay. ... (The Far Eastern Economic Review, 23 January 1986)

Kenya: Laboratory for computer applications in chemistry set up at University of Nairobi

A laboratory for computer applications in chemistry has been set up at the Department of Chemistry, University of Nairobi.

Its aim is to develop the use of computer methods in all aspects of chemical education and research. Essentially, it accepts challenges from teachers and researchers seeking computer solutions to chemical problems, involving both software and hardware. Over the last three years, these have included mathematical modelling of chemical phenomena and analysis of experimental data (orbitals, kinetics, pH systems, diffusion, soil chemistry, structure-drug activity relationships etc.); interfacing of microcomputers to chemical instruments for direct data acquisition and analysis (chromatography, spectroscopy, calorimetry, titrimetry); specialised chemical databases and even student marks. The laboratory also helps in the teaching of computer appreciation and simple programming skills to staff and students.

A major effort is setting up the laboratory over the last several years has been the evaluation and acquisition of microcomputing equipment. So far 3 micros have been bought or borrowed, and more are expected in the near future. We are collaborating closely with other researchers in the university, especially in the Physics Department, from whom we get access to other computer equipment, electronic services and specialized expertise. Their needs are not yet fully satisfied, and they would be pleased to hear from, or of, any potential donors.

The laboratory has recently been appointed a Regional Evaluation and Distribution Centre for Project SERAPHIM, a USA-based network for mostly computer-based instructional materials in science. The laboratory invites all interested persons to take advantage of, and contribute to, this educational resource. The laboratory staff would be interested in active collaboration, help and exchange of ideas with colleagues interested in this important area of chemistry. For information please contact: Dr. Alex R. Tindimubona, Department of Chemistry, University of Nairobi, P. O. Box 30197, Nairobi, Kenya.

Korea, Republic of: Korea gains fast

UK chip makers are taking a hammering from Korea, which is coming up fast on the outside to rank as a top producing nation. The fierce jockeying for position may lead to price wars and exacerbate the current round of legal wrangles in the US, where Japanese chip makers have been accused of chip dumping. These are the conclusions of a new report from market research firm Benn Electronics, which points to Korea trebling overseas sales from $47 million in 1985 to $203 million this year.

Korea is also expected to capture 7 per cent of the US Mos memory market by the end of the year by fierce pricing policies, at the expense of Japanese firms which currently enjoy a stranglehold on the memory market.

The findings are backed up by a second report from research firm Mackintosh International, which claims that by 1990 Korea could rank alongside the US and Japan as a chip maker.

Korea currently has 12 indigenous semiconductor firms; the world's largest subcontract facility, Anam; and seven multinationals.

It is the presence of the indigenous firms which are helping the high tech economy faster than other Pacific Basin countries, since these firms can remain above external market forces.

The Benn report says that, in terms of value added by country, the US held top slot on $9,010 million, with Japan second on $7,600 million. South Korea leapt into third position with $740 million, ahead of PRC's $720 million, and the UK limped into fifth place with just $580 million. (Computer Weekly, 6 February 1986)

Spain invests in Siemens' projects

Siemens has signed an agreement with the Spanish Ministry of Industry under which the latter is committed to invest Pta10,000m (£50m), between now and 1989. The first of four projects contemplated in the agreement calls for investment of some Pta1,800m in Siemens' industrial electronics factory at Getafe (Madrid). Production of robotics, radiological equipment and components is to be stepped up and R&D facilities will be improved. Output value in 1989 is planned to reach Pta8,500m, of which more than Pta5,000m will be for export.

Complete automation of the Siemens low-tension works at Cornellá (Barcelona) will require investment of Pta1,080m, while the third project, involving a new R&D centre in Madrid will cost about Pta:90m. This centre will extend to 1,500 sq m and will employ some 60 people, of whom 50 will be graduates. It will concentrate on developing automated processes.

The fourth project, regarded as the most ambitious, is for setting up a design centre for informatics hardware and software. About 100 new jobs will be created and investment of some Pta1,800m will be required. It is expected that exports of products resulting from the new centre's work will reach Pta6,000m by 1989, split equally between hardware and software. It will be located either in Madrid or in Barcelona; the availability of personnel trained at graduate level in electronics and informatics will be the deciding factor.

By 1989 Siemens Espada expects electronics and informatics will account for more than 60 per cent of company's total output of about Pta40,000m, with exports exceeding Pta9,000m. (Electronics Weekly, 17 March 1986)

Sweden's COMBITECH joins European Silicon Structures group

Combitech, the high-tech company for automation, defence and space technology within Sweden's Saab-Scania group, has joined European Silicon Structures, ES2, as an industrial partner, the company announces.

Together with other major electronic companies from FRG, Great Britain, Switzerland, France, Italy, The Netherlands and Spain, Combitech will make long-term strategic investments in ES2 to produce custom silicon for the design of tomorrow's new products. ES2 will offer European system designers silicon compilers, manufacturing the integrated circuits in a wafer production plant using E-beam direct-write on wafer technology in order to minimize manufacturing cycle time, Combitech says. ES2 products will allow system manufacturers to use VLSI (very large scale integration) chips, to differentiate their products regardless of the size of the production runs, and build their systems directly on silicon, it is added. (Science & Technology [Sweden], January 1986)

United Kingdom: Japan to create 5,000 UK jobs

Japanese electronics investment in the UK will increase considerably during the next two years, and result in a net gain of over 5,000 jobs, most of which will be in the manufacturing sector, according to a newly published report. The report, which has been undertaken by The Economic Development Briefing - an independent market research company, shows that Scotland, Wales, West Midlands, and the North East will receive the bulk of the manufacturing jobs. Most of the jobs in the service sector will be created in London and the South East. Companies from the electronics, automotive, machine tool and optical industries will be the dominant investors. (Electronics Weekly, 12 March 1986)

USSR: Soviet/UK co-operation

The Soviet Union is being encouraged to build its own computers with UK know-how following the signing of a new five-year trade agreement. The long term programme of economic and industrial co-operation between the UK and the USSR, established in 1970, defines specific areas for possible co-operation. The latest agreement includes "equipment for the production of electronic computers, including personal computers" and "communications". (Computer Weekly, 13 February 1986)

Zimbabwe: Currency controls restrict Zimbabwe

Computing professionals in Zimbabwe are not concerned about network architectures and fourth-generation languages; they are too busy worrying about where the next box of punched cards is going to come from and wondering how many more weeks it will be before the replacement disc head arrives.

This picture of computing in a developing country comes from a computing professional in Harare, R. W. L. Trundle, in an article in the newsletter of the British Computer Society's specialist group for developing countries.

Strict currency controls mean everything is in short supply. Trundle says: "Printer ribbons are re-inked until they disintegrate; it is no cheaper than buying new ones, but it does not involve foreign currency."

Punched cards are still used "extensively" but they are not made locally: "The odd carton comes to light occasionally in a forgotten cupboard and is eagerly snapped up."

A disc head crash brought a wait of five weeks for a replacement. Ancient key-to-disc systems keep failing and losing data. There are no spares for air conditioning equipment: "You never know if you will be able to make it through tomorrow, let alone print the salary statements at the end of the month."

Staff shortages are "chronic": UK and US "colleges" take students valuable foreign currency and send them back with "impressive looking pieces of paper" which are of little value.

This, plus the exodus of white people when majority rule was achieved, has meant rapid promotion for inexperienced people.

Trundle's views are confirmed by Julian Bogod, director of the UK Council for Computing Development.

"The comments about qualifications are typical of developing countries," he says. "Where proper training is given overseas it tends to be academic, with no practical experience.

"These views back our argument that we should be helping these countries to help themselves. It's ridiculous that they can't get simple things like paper. Proper planning should take care of regular supplies of consumables and spares." (Computer Weekly, 13 February 1986)

STANDARDIZATION AND LEGISLATION

Compstan 86 to explore future standards directions

The dynamics of standards use is the focus of the 1986 Computer Standards Conference in San Francisco, California, from 13 to 15 May. Buyers of computer products and builders (suppliers) of computer products that must conform to standards will come together with developers of standards to address some provocative issues.

What should be standardised in the computer industry? How should builders implement new standards, and how should they apply old ones? How should buyers select computer products? Let's start thinking about these important questions now.

Right now, computer standards bodies such as the IEEE, EIA, and X3 will accept a project authorisation request for the initiation of a new standard from anyone who can fill out the required paper work. Screening committees put in place by these organisations do eliminate absurd suggestions. Co-ordination with the American National Standards Institute reduces redundancies.

But, do we want subjects for standards to be introduced at random? Should there be an organised effort to set directions for selecting subjects to be standardised?

The Department of Defense has spent hundreds of millions of dollars to create and implement the Ada programming language for the benefits of a standardized language. The department mandated that Ada be used on military projects.

But, it is expensive to buy an Ada compiler (about $25,000) and to train programming teams to use Ada. To date, only about 20 per cent of current military projects are implementing Ada. The other projects have found reasons for not using it. The Defense Department is using a forceful approach to implement a standardized language.

Another approach to standardize a language (and other things) is to let free enterprise run its course. Take, for example, Borland International, a commercial software company in Scotts Valley, California. Borland is selling a Turbo Pascal compiler for $69.95.

At last count, more than 100,000 copies of this Pascal compiler had been shipped to customers. With this number of users, Turbo Pascal becomes a de facto standard. (What would happen if the Department of Defense asked Borland to implement Ada?) In what other ways can new standards be implemented effectively?

Gordon Bell, in his keynote address to Compcon in 1984, outlined how the Japanese had taken an old standardized language (Fortran) and a de facto, standardized computer architecture (IBM 360) and optimized them to produce some of the world's fastest computers.

The Japanese didn't proliferate new languages; they didn't create new architectures. They simply used well-accepted conventions. Should our computer industry be following the Japanese example in standardizing what's available as opposed to developing new standards?

Pity the poor buyer selecting a computer product today! The number of alternatives in most cases is staggering. In addition to the overwhelming number of products available, the functional, quality, and reliability characteristics of products are defined differently by different manufacturers (if they are provided at all). How can buyers compare computer products intelligently? Is a buyer's standardization effort called for?

At Compstan 86, some of the leaders of the computer industry will be gathering to debate these and other questions about standardization. Even though Compstan 86 is officially a conference, it will have a workshop orientation (hecklers will be pleated) that should lead to some lively discussions.

The technical program committee has had a favourable response to its call for papers and has answered many telephone inquiries about the conference. A varied program and a good turnout is expected.

John Brown, Jr., at Burroughs Corp. is in charge of conference registrations. His telephone number is (619) 438-3000. Bob Poston is chairperson of the technical program committee. He may be contacted at (201) 918-0110. (IEEE Software, January 1986)

EC's £84 million standard hopes

European efforts to harmonise information technology standards were given a major boost this week with the announcement by the European Commission of £6 million worth of contracts to establish standards testing facilities.

The EEC hopes that the testing facilities will remove barriers to IT trade by making products tested in one country acceptable for sale throughout Europe.

UK contractors for the testing facilities are the National Computing Centre, British Telecom, the BSI and Ecsys.

The contracts come a week after IBM and DEC joined forces in the UK with ICL and British Telecom to develop testing systems for Open Systems Interconnection. The two events highlight the growing strength of the standards movement.

The money will allow testing services to be set up in six to 18 months. The contractors, who will be paid by results, will match the money provided by the Commission

The NCC and BT will work with the National Physical Laboratory to develop OSI testing facilities for levels 4-7 of the OSI model.

Ecsys has won funding to set up a testing centre for local area networks on levels 1-4 of the OSI models. Ecsys will work in collaboration with a Dutch partner, Kemsy, which runs a testing centre for electronic and electrical products.

David Firnberg, managing director of Ecsys, says there is already a significant user demand for standards. "The problem is that there are many possible variants on the ways in which manufacturers interpret standards when they embody them in products. It's fair to say the UK is already on the forefront in installing Lans. I'm sure this testing facility will give the UK a lead."

The British Standards Institute is to set up tests for Pascal validation. Also on the software front, the NCC is to set up conformance testing for the graphics standard GKS (Graphics Kernel System) and Cobol.

The EEC has tried to spread the contracts as widely as possible throughout Europe. The work to develop the harmonised testing facilities will be shared among the UK, France, Germany, Italy and the Netherlands but testing services will also be provided in Denmark, Spain and Ireland. The EC is currently expected to fund only two testing services per technical area.

The largest contracts are for the OSI layers 4-7 conformance tests. The work will be concerned with standards testing in four areas - packet switch systems, X.400 message handling services, teletex terminals and file transfer, access and management.

There are seven principal contractors on these projects - apart from the NCC and BT, the rest are PTTs in Europe.

BT and NCC only shaped a joint proposal as a result of the EEC's call for bids. Historically the NCC has taken a lead in this area, and the government would probably prefer that BT as a privatised company does not get a monopoly on UK testing. (Computer Weekly, 27 February 1986)

Firms join in standards push

At least 18 of the leading computer and telecom equipment makers are joining forces to get standards that would enable their various systems to share information. IBM is notably absent from the group.

The group is attempting to counteract IBM's SNA (Systems Network Architecture) which has become an increasingly important tool in helping IBM dominate

the computer market. The major IBM competitors are trying to speed up the refinement and application of the Open Systems Interconnect system.

The group is funding a non-profit organization that will specify standards and the tests for compliance with the standards. The organization is to be called the Corporation for Open Systems. The initial members agreed to put in $125,000 each for the first year and $200,000 each for the second.

The backers include: AT&T, Amdahl, Bell Communications Research, Burroughs, Control Data, Digital Equipment, Harris, Hewlett-Packard, Honeywell, NCR, National Advanced Systems, Northern Telecom, Perkin-Elmer, Sperry, Tandem Computers, Telex Computer Products, Wang Laboratories and Xerox. (Electronics Weekly, 22 January 1986)

UK first with parallel processing standard

British researchers plan to publish the first standard for open systems in parallel processing computers next autumn. The standard will allow the necessary new languages to be run on different machines.

This is important because future machines will only sell if they can handle software written in these languages. The standard is being developed by universities and industrial research teams as part of the Alvey programme.

The standard will be a major input to the recently announced Alvey Flagship project to develop fifth generation computer technologies. "If we keep our heads down and make hardware and software that is peculiar to ourselves then we won't have any viable products," said Colin Skelton, who is the project manager of Flagship and works at ICL's Mainframe Systems Division.

Speech recognition, artificial intelligence and other fifth generation applications need different languages, known as declarative languages. These allow users to tell the computer what they want done without saying exactly how to do it, so the computer system can figure out the best way to tackle the problem.

The key to having open systems in the future will be a standard interface that links all of these declarative languages with all of the hardware. Such an interface is being developed at the University of East Anglia and is called the Declarative Alvey Compiler Target Language (DACTL). This is the basis of the standard that will be published next autumn.

A primitive compiler target language called Alice-CTL has been implemented on the Alice parallel processing machine that ICL has recently built to a design from the Imperial College of Science and Technology. According to Skelton, the next stage will be to run one of the new declarative languages on the machine using Alice-CTL to prove the concept.

For the standard to be meaningful it must be internationally accepted, particularly in Europe, Japan and the US. (Electronics Weekly, 1/8 January 1986)

Europe sees start of MAP movement

The European MAP (manufacturing automation protocol) movement took off in earnest with the elections for the first European Steering Committee.

The first full meeting of the Committee, which will include 15 users and five vendors, was held in Italy in February, and the first European MAP testing and validation centre will be established at the Fraunhofer Institute in FRG during the course of the year.

A World MAP Council is also expected to be formed within the next few months, bringing together the US and European Committees, as well as parallel movements in Canada and Japan.

"There is rock solid determination worldwide that there will not be two MAPs," said Nicholas Beale, founder member of the European users group.

Fuelling the growth of the MAP idea, General Motors is expected to bring the specification into the public domain in 1986. The specification is currently only available in the form of a GM document, making it more than a little awkward for other major manufacturers to demand MAP conformity on requests for tenders.

But the real hot topic is whether or not the next release of the MAP protocol will appear this year. Vital issues to be addressed in the second version include the development of a real time sub-network and the establishment of a manufacturing messaging service standard. The existing version 2.1 uses General Motors' own Manufacturing Messaging Format System, but the general consensus is that the next version is likely to include a dramatically better but incompatible system developed under the auspices of the CCITT and the ISO.

The one thing that is certain is that GM is committed to using the broad band token bus for the foreseeable future to keep MAP 2.1 as a technically stable subset of future releases. But equipment manufacturers need to be careful on the messaging issues where no true standard has yet been defined. A spokesman for the steering committee said that they would be well advised to use only those facilities in the General Motors MMMS system that also exist in the newer, cleaner MMS, formally known as EIA RS 511.

Esprit has given its blessing to a consortium of major companies in their efforts to establish an open systems architecture for all computer based manufacturing and business activities. (Electronics Weekly, 1/8 January 1986)

Euro MAP standards win wide support

The European effort to set standards for factory automation based on General Motors' MAP protocols is supported by over 180 companies.

In the UK 70 manufacturers are involved in developing MAP (Manufacturing Automation Protocol) in Europe.

At a series of meetings during February the European Map Users Group (EMUG) agreed "a significant programme of technical work", according to Nicholas Beale of Beale International Technology, who is to chair one of the group's working parties networking.

Two other working parties were set up, one looking at the full architecture of MAP networks and network management issues and the other dealing with messaging and process control.

EMUG has established strong links to the US MAP group to ensure that work is not duplicated. It has been agreed that EMUG should take the lead role internationally on fibre optics.

There are also plans to liaise with Esprit research groups that are working in network standards.

The user group also elected a new steering committee and a technical committee. The aim of the European group is to bring about a worldwide MAP format with European suppliers producing products.

The US has so far taken the lead in MAP, largely because it was originally developed by General Motors as an internal specification for communications between different computers in its factories.

Because MAP is seen as a key to reducing production costs, General Motors competitors in the automotive sector were fastest on the MAP bandwagon in Europe. The German machine tool industry is well represented, as are the oil companies.

According to Dave Bisset of Cranfield Institute of Technology, which is running the EMUG secretariat, all sectors of industry are represented. Many members are actually potential vendors of MAP systems, and Bisset points out that they have an inherent role in developing MAP systems. (Computer Weekly, 13 February 1986)

IBM's encounter with the Unix standard

The operating system of IBM's PC/RT scientific/ technical microprocessor is the Advanced Interactive Executive (AIX), developed by IBM in co-operation with the software firm Interactive Systems. This choice by IBM has a bearing on the struggle it is carrying on with ATT, in as much as AIX is an improved version of the Unix version 5 which the latter is attempting to make a standard. Surely IBM must have considered Unix's good suitability for multistation configurations, since the PC/RT is able to function as the central system for a further seven screens or microcomputers. However, IBM must also have considered that AIX, in addition to following the standard advocated by ATT, is also putting its role in question by the improvements it has introduced.

ATT has achieved progress in the acceptance of Unix version 5 as standard in commercial applications, although it also encountered an obstacle in this field, the unknown factor brought into being by IBM's possible support for Xenix, a different version of Unix developed by Microsoft. In the world of industrial applications the best accepted Unix version is the 4.2 bsd. ATT, towards the end of last year, set itself the goal of achieving a standardization of operating systems with Sun microsystems, one of the three most important firms (before IBM's invasion of the field of technical microinformatics). ATT's progress in this regard is now put into question by IBM's response.

Among the improvements made to Unix version 5 by AIX, the basic one is that of giving support to the PC SQL/RT relational database, in order to improve virtual memory handling and to facilitate its use by unskilled operators by means of special menus and commands.

Even if IBM has spent years researching Risc architecture it is surprising that more time did not pass since Acorn, the Olivetti subsidiary, last year began to sell the first computer with this architecture. The twofold purpose, as a tool to gain access to a market and as the launching of an operating system with the possibility of its becoming a standard, is able to explain why IBM has not delayed its launching, thereby abiding by its custom of letting other manufacturers consolidate the acceptance of a new technology before using it in force.

The most recent news in relation to Risc architecture is the presentation of two new models incorporating it in the 3000 series by Hewlett-Packard. By the end of the year the 3000/930, which attains 4.5 mips (millions of instructions per second), will be available and, by mid-1987, the 3000/950 which attains 6.7 mips. The problem to which HP states it has dedicated 80 of development time was that achieving compatibility with its earlier equipment. HP has succeeded in designing new machines by replacing a certain number of printed circuits in its earlier equipment and has at its disposal new compilers suitable to take advantage of the possibilities of the new architecture. (IBIPRESS Bulletin, No. 72, 17 March 1986)

EEC to demand protective laws for chip designs

The EEC is to instruct its member states to introduce legislation that will protect microchip designs. An EEC Council directive is to be issued shortly telling member states that they must introduce legislation as soon as possible on the lines of the US Semiconductor Chip Protection Act (1984). This law prevents the product and distribution of copied or "reverse engineered" microchips throughout the US.

The EEC move has followed growing concern that EEC-originated chip designs are suffering the same fate as some US designs and being copied in countries such as Taiwan. Such chips are then being distributed in Europe.

The EEC comitted itself to introducing some form of legislation following an agreement with US officials signed in June. Under this agreement, EEC companies get protection for their designs in the US for a period until September 1986. This may not be renewed if it is considered that the EEC is not making good progress.

The situation is being viewed with some urgency in countries such as France and Germany, where existing copyright protection cannot be construed to cover microchips. In the UK, officials believe that existing copyright legislation does cover microchips and that new legislation would be needed only to ensure some form of consistency with forthcoming EEC and national laws. There is still a danger that designs such as the Inmos Transputer could be copied and then reintroduced into European states other than the UK. Because of the strength of the UK copyright law, the US has given UK companies the maximum three-year protection period under the US Act.

But proposals for new copyright laws, which are expected to appear in a government White Paper next year, may change the laws with regard to microchip protection.

A leading specialist, who has been advising the EEC, commented: "It is believed that a fair amount of chip piracy goes on in Hong Kong and Taiwan. There is some evidence that this is happening to European designs".

In late November, the World Intellectual Property Organisation published a draft treaty on semiconductor protection intended as a guideline to legislation. This is based broadly along the lines of the US Act. Japan, the Netherlands and Australia are among countries set to introduce legislation shortly. (Computing the Newspaper, 12 December 1985)

UK, US software suppliers face liability target

The software supply industries in both the US and the UK are concerned about legislation which attempts to make suppliers liable for defective products.

A consumer rights protection bill for computer products introduced in the California legislature last year has had its passage delayed after opposition from the US services industry and is now expected to be re-introduced early next year.

But an EEC directive that will have a similar effect in establishing suplier liability for all kinds of products, including software, is set to become law in EEC member countries.

The US Bill (number 1507) was introduced in California last spring. The bill seeks to give protection to anyone buying software which turns out to be defective in any way or fails to carry out its advertised claims.

Customers would be permitted to return products up to six months after the sale and if the warranty had been breached, triple damages could be claimed in the case of any legal action.

US software is presently sold with a disclaimer on the product working without any faults and the software publishers claim no responsibility for any problems the software may cause for customers.

The bill has galvanized the software and services sectors into opposition. Software houses are fearful that the bill will leave them vulnerable to damaging lawsuits, since software bugs are a fact of life in almost any software package no matter how reliable or well tested the product is.

The major US trade organization, the Association of Data Processing Service Organizations (Adapso), has responded to the proposed bill by organising a working committee to come up with alternatives to legislation. ...

The spectre of similar laws being introduced in the UK and other European countries has been raised by an EEC council directive, which was issued in July and which must be enacted by member countries in their national laws within three years.

The directive (85/374/EEC) deals with "the approximation of laws, regulations and administrative provisions of the member states, concerning liability for defective products". It will make the supplier of any defective product liable for damages caused to customers or their property and although reference is made to "hazardous" defects, damages of a commercial nature are also covered. The directive appears to apply to all kinds of goods, including software and other computer products ... (Computing the Newspaper, 9 January 1986)

Sydney case may set legal precedent

Australian law courts may have made legal history by upholding the case of an end user who sued a computer supplier for providing defective software. The legal decision comes at a time when the US and UK software supply industries are concerned about proposed legislation attempting to make suppliers liable for substandard products.

The New South Wales Federal Court awarded a total of $26,000 to Sydney-based Chipendale Printing to cover the full cost of the software, together with damages and compensation. Chipendale had sued the local vendor of a US package of cost-estimating microcomputer software that was found to lack the capacity it was represented as having.

The judge said that the defective performance of the software was so basic that the vendor must have known of it, unless he had not checked the software or was not competent to assess it. Whichever applied, he found that misrepresentations had been made in breach of the Trade Practices Act.

The managing director of Chipendale told the court that the supplier "assured me that the computer would do exactly what we were presently doing manually - but in a fraction of the time". (Computing the Newspaper, 23 January 1986)

Users profit from a licence to piracy

A three-cornered fight is going on over site licensing: between micro software houses, dealers and large corporations. At stake are large shares of the revenues generated by the applications software market - about £400 million in Europe last year.

Site licensing has become a big talking point among users of large numbers of packages.

A software house gives a master copy of a package to a firm, with permission to make as many copies of the package as it likes for internal use.

At times the idea is confused with "volume purchasing", when discounts are given for buying large numbers of individual packages, and "network licensing", when a master copy of a package is given for use only on a single multiuser machine.

What do the three contestants stand to lose and gain by site licensing?

Software houses will be able to cut out the middlemen (distributors and dealers) and be sure of some revenue whenever the site licences come up for renewal - one of the principal reasons Compsoft gave for its move. But they risk alienating dealers, who might feel they were being cut out of the money-making chain of selling packages.

Dealers point out that the one-off sale of single packages is a source of revenue ignored by software houses at their peril.

"The site licence and the margins make it nearly not worth selling the packages."

The good points of site licensing for dealers are hard to find. If the software house sells direct to the user, what can the dealer do?

Not knowing which department is using what package is one of the obvious organisational drawbacks for the holders of the site licence. At Ashton-Tate, UK managing director Gary Hobbs notes, "some corporate accounts don't want site licences - because they want control of the copies of packages in use".

Site licensing has two big advantages for users: it is cheaper than buying lots of packages individually, and it avoids prosecutions for piracy.

Some software houses want to offer licences, but are scared of dealer reactions. Some dealers might welcome it, but are unsure of its final effects. And the users are holding the reins. (Computer Weekly, 20 March 1986)

US lawyers warn about copyright

US lawyers have renewed warnings that software houses which attempt to re-write their rivals' packages are almost certainly in breach of US copyright law. Judgments in the US over the past three months have backed the contention that software which copies the ideas in a program, without any copying of the source and object code, is still a breach of copyright law.

A spate of lawsuits is expected in the US over the next year following a series of judgments on the issue which have almost unanimously backed the complainants.

Michael Scott, executive director of the Center for Computer Law, said that he disagreed with those who want to protect the audio visual display. This would stifle innovation and restrict the choices of the user, he said.

Manufacturers have also expressed concern, particularly IBM. They believe that there could be delays in bringing out new hardware products while royalties are arranged, even in cases where software has been re-written across from one machine to another.

Whatever the outcome of at least three cases due to be heard next year, companies such as Micropro are unlikely to benefit. Its Wordstar system is so widely copied that a court would probably view it as non-proprietary. (Computing the Newspaper, 28 February 1985)

Changes in Swedish law to fight computer-related crimes

Changes in Sweden's Data Protection Act will in the future include penalties for "computer fraud", if a government bill presented on 25 November 1985 is adopted by the Riksdag. According to the bill, a person who illicitly influences the result of an automatic process - computerized information processing, for instance - to his own gain, will be liable to fraud. At the same time, the bill proposes minor changes in the Criminal Code in order to counteract such computer-related crimes as wiretapping and the illicit use of computer equipment via time theft.

While computer-related crimes in Sweden are believed to be of rather modest proportions so far, they can be expected to increase in the future, says Minister of Justice Sten Wickbom in a comment. It is therefore essential to formulate legislation now so that such crimes can be fought with simple and effective means. (Science and Technology [Sweden], January 1986)

Lawyers link up to discuss dp

The European Commission is backing a plan to organise a committee of European lawyers to consider issues involved in computer law. The first meeting of the committee will be at a conference in Brussels in March. It will focus on the legal aspects of paperless trading in the EEC.

One of the prime movers behind the initiative is Professor Michel Vivant, a French lawyer specialising in computer law. The committee is to be called Committée Européen Lex Informatica Meritatorique (Celim). It is being organised jointly by Celim and the Conference Office Brussels, which specialises in organising international associations.

A spokesman described the main aim of the new committee as "reflecting at a European level between computer lawyers whether university lecturers, practising lawyers or members, of European institutions, the legal problems produced by data processing and telecommunications in international business practice". Celim plans to hold conferences annually. (Computing the Newspaper, 23 January 1986).

SOCIO-ECONOMIC IMPLICATIONS

The social impact of the new electronics technologies

The Nippon Institute of Advanced Research (NIRA) in its most recent bulletin summarised an important study ordered from the Nomura Research Institute on the social impact of new electronic technologies (NET) and its effects until the year 2000. Taking its departure from the work of ten experts, the study discerns negative aspects in said impact, not only due to the potential increase in unemployment and social control, but also due to effective discrimination against minorities in a poor position with respect to any change by reason of sex, age or race. The attainment of the possibilities offered by NETs of daily social improvement in the short term make it possible to increase independence, better exploit economic and cultural opportunities and increase the wellbeing of communities, but they require prior governmental, social and personal adoption to achieve greater goals of occupational/professional training and scientific, technical and cultural knowledge.

The predictions detailed in the study on NETs of information, communications, control and energy cover 12 areas of social impact, some infrastructural (environment, resources, international relations, administration and politics), other economic (industries, labour, transport, cities) and still others personal (health, education, culture and home), even though all of them are closely interrelated.

As far as the environment is concerned the greater forecasting of natural phenomena (weather, harvests, water supply) will have an influence thanks to geodata bases which will improve territorial planning and the reduction of catastrophes. Electronics will improve prospecting, the exploitation and utilization of resources, the turning to advantage of reserves by drawing on those inaccessible today, thereby opening new sources of energy and materials or by economizing on consumption. Internationally speaking, NETs have a way of promoting specialization and trade, but could generate new forms of prepotence and dependence. Nets bring about more informed but more easily manipulated political participation, while making possible the administrative rationalization or its discussive strengthening against the citizen.

NETs increase productivity and economic efficiency, both in large and small production series by making workshops, stocks and communications more flexible as far as neutralizing scale economy and becoming adapted to specific requests. Tertiary sectors will widen to new fields with more value-added functions, capable of adapting research and overall planning of sectors and industries to socio-economic changes. Distribution will more closely match use and consumption without losing overall co-ordination, with greater commercial competition among manufacturers, distributors and consumers.

The new opportunities for employment and within the field offered by NETs do not conceal the personal, social, political and economic problems linked with occupational mobility and conversion. Transport will be streamlined to gain in comfort, safety, space economy and consumption, whereas telecommunications will render certain types of transport to work, shopping, study or meetings of managers obsolete. It will be possible for citizen services to improve and widen through NETs, above all those vital to community life (water and energy supplies and communications - waste disposal and disaster prevention), but at the price of a greater vulnerability caused by local breakdowns of very much interconnected fragile systems.

NETs will improve health through the selectivity of analytic diagnostic tests, of medical treatment efficiency or of the introduction of artificies to supplant human functions, with the intensive utilisation of health cards and expert systems to assist medical knowledge. Also education will

receive stimuli to the personalization of teaching, to raise its levels, free it from the restraints of space and time and strengthen the human contact of the teacher to forge the pupil's aesthetic outlook and character. Culturally speaking, NETs will create new media of expression and improve reproductions, with the known perils to creativity, emotion and lyricism of an aesthetic work. For daily life at home, NETs will supplement the handiness of household and family chores by allowing more time for other activities, facilitate the planning of family expenditures and permit the increase of occupational/professional work in the home, without however obviating risks to privacy and communications outside the home. (IBI Press Bulletin, No.68, 17 February 1986)

Technology application and employment

Discussions on the impact of technology on employment are continuing. Will new jobs be created or will the ranks of the unemployed swell? According to a study conducted recently by ILO, the only sure thing at the moment is that employment possibilities for unskilled workers will decrease, while opportunities for highly skilled tradesmen will tend to increase. Also older workers, being less adaptable to new technologies and to the new working environment, will form a particularly vulnerable group. Moreover, every single industrial sector as well as sectors that are identical but in different countries, will be influenced by new technologies in a different manner, the study indicated.

In the electronics field the forecasts concerning the occupational profiles speak of drastic changes. Much greater than those that it seems will be occurring in the ready-to-wear sector. In the latter case, the new applications will be introduced gradually. Thus also the changes in manpower demands will proceed in the same manner.

When considering one and the same industrial sector in the various European, American and Oriental countries, considerable differentiations can be noted. According to the bit survey, the introduction of electronics, particularly of microelectronics, into automobile factories could create much greater employment imbalances in countries like France and Italy than in Japan. The last has in fact begun its gradual automation programme long ago, whereas the first two, in which the proportion of manpower utilized is still high, are likely to experience more pronounced effects of the introduction of new technologies.

The introduction of new technologies frequently occurs in concomitance with the reorganisation of work and/or with changes in models and production factors. It is therefore difficult to establish which and how many jobs suppressed may be ascribed to the application of technology rather than to the fresh organisation of the production process. The study, conducted after the robotisation process at the Italian Fiat factories, has shown that the reduction in jobs of 40 was attributable to new applications only to the extent of 5.

Resistance to technological changes, which in this sector very often characterises the less advanced countries which also have a rather inflexible labour market, does not seem to be the solution to unemployment problems. The case of the British printing industry was stressed in this regard.

The employment drop in this sector depended in practice on the late introduction of electronics into the production process. The drop in productivity that resulted led to poorer competitivity on the domestic and international markets and therefore to the closing of a number of printing houses.

It has been deduced from this that the employment battle does not take place in the field of company technological modernization alone, but much more in the political field. In fact, for purposes of a balanced development in the technological sector, innovation must be counterbalanced by innovative formulas of social policy, particularly in the occupational training and requalification field. (IBIPRESS Bulletin, 19 January 1986)

The Robots are on our side

"No to the computer", "Jobs threatened by micro-electronics", "Computers will soon put every fourth person out of work". Three typical headlines from recent years. If such statements have had a considerable impact, this is because they echo an existing attitude (and are at the same time a product of the same attitude). Pollsters have termed it "a national phenomenon": by comparison with other countries Germans are hostile to technology. And the computer bears the brunt of their mistrust. According to a survey carried out by the Allensbach Opinion Research Institute forty per cent of the population agrees with the view that "the rationalisation made possible by modern technology is to blame for the high unemployment rate, because machines put people out of work".

At first sight it may not seem to have been fortuitous that the introduction of labour-saving technological innovations coincided with high unemployment. It looked as though a policy of modernization at all costs had put people out of work. But on closer scrutiny this view will not hold water. A comprehensive report on "The Effects of New Technologies on the Labour Market" (the so-called "Meta Study"), commissioned by the Ministry of Research and Technology as a review of all the existing studies on the subject to date, comes to the following conclusion: it is in those concerns which record low rates of growth and have resisted the introduction of new technologies (thus weakening their competitiveness) that jobs are jeopardised, while the more outgoing sectors of the economy which are stepping up their productivity by implementing technological innovations are in fact creating new jobs. Consequently, the few manufacturing sectors which have fully rationalised their production processes have managed to contain unemployment and at the same time set new technological and ecological standards. The car industry is the most striking example of this trend: it is largely thanks to microprocessors that road vehicles have become safer, more economical and less of an environmental hazard. And this is not all. Daimler-Benz managing director Werner Breitschwerdt ushered in the new year with the following notable statistics: "In the last two years 40,000 new jobs have been created in the German car industry, a quarter of them in Daimler-Benz alone." And: "The mean employment figure in the German car industry in 1985 came to 805,000, the highest level ever." This record had been achieved, it should be remembered, in an industry which accounts for some 60 per cent of all the industrial robots in the Federal Republic of Germany. The leading manufacturer with the largest percentage of robot-utilisation, Volkswagen, has developed what is currently the highest degree of mechanisation worldwide in the assembly process of its Golf. The concern decided on a policy of maximum rationalisation to maintain its competitive edge on the domestic and world market.

Nobody is denying that mechanisation makes part of the human workforce redundant. In component handling one robot can replace five to six people, in component processing two to three. But this redundancy is amply compensated by the dynamic side-effects on the employment situation which mechanisation generates. By enhancing competitiveness it actually creates new jobs.

particularly in the pre-assembly and post-assembly stages of production. In the case of Volkswagen, the company's turnover has risen so sharply that its employment figure has gone up by 7,600. The German car industry has managed to maintain its twelve per cent share of the world market. Some four million jobs - a seventh of the national total - are directly or indirectly connected with vehicle manufacturing. In 1985 around 4.5 million vehicles in all categories were produced - eleven per cent more than in the previous year - making the car industry the nation's strongest sector with a total turnover of 140,000 million marks. This figure represents almost a twelfth of the gross national product (the total of all goods and services within the country). The banking and insurance sector has also pursued a policy of technological innovation. And it has belied the predictions that the introduction of new technologies (in this case electronic data processing) would result in the loss of jobs. Instead it has produced improved standards of customer service. In the period 1980-1984 the sector's total employment figure rose by 23,000 (3.1 per cent). Other large-scale German concerns - like the Bosch Group - have the statistics to prove that they could not have survived periods of recession unscathed without micro-electronics. The documentation published by the Research Ministry in conjunction with the report on "The Effects of New Technologies on the Labour Market" concludes: "It was not the concerted rethinking in the technological and organisational fields and the resultant higher productivity which led to the loss of jobs but rather weak growth rates and increased competition on the world market. Thus, the causes of the continuing high rate of unemployment are to be sought partly in demographic factors and the slow reduction in working hours by comparison with the seventies, but also in industry's reluctance to embrace new technologies." This conclusion is corroborated by comparative studies which show that supply on the labour market "is significantly affected by demographic, structural and international competitive trends".

Between 1970 and 1977 the number of jo _ dropped by approximately 1.1 million, while the unemployment figure rose by about 900,000. In the next seven years, while industry was beginning to implement modernisation programmes, the number of jobs first of all (in 1980) climbed back to the 1970 level and then, even during the period of severe recession, equalled the 1977 level by 1984. Thus, the number of jobs available remained constant between 1977 and 1984, even after new technologies had been introduced. The level of unemployment more than doubled (+ 1.23 million) during the same period due to demographic trends. Between 1979 and 1984 an extra 1.25 million people were looking for work. The slowing growth rate was another negative factor: the gross domestic product was low, productivity was slowing (from 1969 to 1974 productivity per man-hour rose by 4.77 per cent, in 1974-1979 by 4 per cent and in 1979-1984 by only 1.9 per cent annually).

The arguments in favour of technological innovation are likely to become even more persuasive in the coming years. There is evidence of this today in the software sector. By comparison with the hardware sector applications, operating and control systems have a great deal of ground to make up. Current projections put worldwide turnover increase rates at 20 to 25 per cent a year. This will be reflected most strongly in the new professions, above all in the media. The future undoubtedly belongs to telecommunications, a field in which several hitherto separate lines of technological development - data processing, communications engineering, the electronic media, cable transmission and the print media - are merging together and opening up new scope for the use of satellites, video technology and teletex. By 1984, "Orwell Year", the worldwide communications market had climbed to a turnover figure of 475,000 million marks. Within this field telecommunications will account for a significant proportion of future growth rates. It has been estimated that in the coming decades the countries of the European Community will spend 15,000 million dollars just on telecommunications infrastructure, let alone the further billions that will go on the requisite hardware. The existing plans involve countless new jobs and new professions. It is already clear today that high standards of vocational qualification are going to be necessary - a requirement which will exclude many applicants: unskilled and semi-skilled labourers, older applicants and in fact all those whose jobs are already insecure now. For all of these it will become increasingly difficult to find work. This is borne out by a study compiled by the Institute for Social Research and Social Policy in Cologne, which concludes that many Germans, among them first and foremost women who tend to be afraid of technology, are going to have to rethink their attitude towards the new technologies or find themselves missing the boat. Innovative systems like micro-electronics or industrial robots, today decried as "job killers", will be indispensable in 15 years' time if the Federal Republic of Germany is to maintain its standard of living and finance its state pensions scheme.

In 1985 it took 100 incomes to provide 38 pensions. By the year 2010, if demographic trends continue as projected, 100 incomes will have to finance 45 pensions. In a press conference Research Minister Riesenhuber recently stated: "The decline in the population figure and the consequent drop in the number of people employed between now and the turn of the century will have to be compensated by enhanced levels of productivity if living standards are not to suffer. The only way to do this is to make full use of technological advances. Greater productivity must be reflected in higher incomes which are channeled through the social security system to benefit pension-recipients." (SKALA, FRG, April 1986)

Newtech impact on jobs

What has been the impact of the new technology on jobs in Britain? Has its introduction been blocked seriously? Has it resulted in big job losses? Have the trade unions been entirely negative? At the moment, the answer is that acceptance of newtech at the place of work is a non-problem. More important is to explain and analyse why it has been accepted - and whether it will continue to be in future.

The Policy Studies Institute (PSI), an independent British group, in a study commissioned by the Economic and Social Research Council, and funded by the Department of Trade and Industry,* have found that:

1. Fears of opposition at the place of work to block the introduction of newtech have not been supported. On the contrary, there has been widespread acceptance. A survey of factories using newtech found only 7% opposition from the shop floor, or the unions, to be a major obstacle. In offices, only 6% of staff were opposed: 67% of secretaries and 74% of typists welcomed word processors.

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* Chips and jobs: the acceptance of the new technology at work, Policy Studies Institute, 100 Park Village East, London NW1, 1985, £8.95.

2. Big job losses have been the exception. Average annual jobs loss is one per factory, compared with the total for the country of between 15,000/20,000 per annum. The problem is not a drop in the total number of jobs, but a shift in the kinds of jobs to those needing newtech skills.

3. Trade unions have co-operated. They have sought advance consultation, a say in how the newtech is to be used, protection from possible hazards, avoidance of worsened work conditions, preservation of jobs, and a share in the benefits of improved productivity.

4. Work conditions have improved. There have been relatively small changes in the nature of work for a limited number, but overall those affected by such changes have been given increased work satisfaction. These are modest, but real, improvements.

5. As these are early days, wider use and more advanced application could bring trouble unless there are positive policies adopted now.

The study recommends negotiated change, increased training, and re-training in the newtech skills, and macro-economic policies producing higher employment so that those displaced have opportunity of a new job elsewhere. (See table 3, page 55.) (Outlook on Science Policy, December 1985)

US service industry sees 'rise in jobs'

Computer and health-related professions will experience radical growth in the US over the next decade, the US Bureau of Labour Statistics reports. The bureau says the report is the strongest indicator to date of the extent of the transformation of the US economy from an industrial base to a service-oriented one in which computers, telecomms, health and business services are the driving forces.

The fastest growing occupations in the US will be computer programmers and analysts, paralegals, medical assistants, technicians and engineers who specialise in computers and electronics.

According to the bureau, nine of every 10 jobs created in the next decade will be in service industries. Manufacturing jobs will continue at sluggish growth. Manufacturing employed 20 million people and accounted for 25% of all jobs in 1969.

Manufacturing has declined in both numbers and percentage of the workforce, the bureau states. However, it is expected to expand moderately in the next decade.

Many US service jobs are currently at the lower end of the salary scale. But the bureau predicts that several highly skilled and higher-paid job categories are expected to grow more rapidly than average. Technical and professional jobs could increase 21% and 28% respectively. (Computing The Newspaper, 28 February 1985)

UK: Fear for patent jobs in shake-up

More than 250 jobs have been placed at risk by the Government's plans to computerise the Patent Office, following its hive-off from the Civil Service. Unions say that they have details of 265 positions, mainly clerical, which face the axe when the multimillion pound computerisation project goes ahead. They are particularly concerned about the proposed transfer of 175 employees from a data processing pool at Orpington in Kent.

The Government intends to increase radically the efficiency of the organisation, in the face of increasing competition from the European Patent Office and it also wants to see the office provide better services. A spokeswoman for the Department of Trade and Industry, which controls the Patent Office at present, commented: "It's too early to speculate what effect on jobs there will be". (Computing The Newspaper, 14 February 1986)

Job projections

One of the most telling influences of data processing upon public policy has been the elevation of economics into the realm of mathematical study. Many economists consider the subject a science, but without the ability to create laboratory conditions, the assumptions from which econometricians calculate their findings are little more than guesses. Thus, no matter how detailed the formulas and extensive the data tables, long-term job projections are at best educated guesses.

However, since they are "the only game in town", some of those analyses are worth reviewing. For example, the Congressional Research Service has summarised and interpreted the findings of Faye Duchin and Nobel-prize winner Wassily Leontief, which appeared in their study, "The Impacts of Automation on Employment, 1963-2000". ("The Computer Revolution and the U.S. Labor Force", a study prepared by the Congressional Research Service for the Use of the Sub-committee on Oversight and Investigations of the Committee on Energy and Commerce, US House of Representatives", March, 1985)

The study is based upon the dynamic Input/Output model created by Leontief, Duchin, and Daniel Szyld, which is used to measure and calculate employment, output, and investment in 89 individual industries, over nearly 40 years, involving 53 different occupations.

Breaking the US workforce into nine general categories, the CRS estimates that the fastest growing occupational group will be professionals, rising by 123.7% over the period from 1978 to 2000 and jumping from 15.6% of the US workforce to 19.4%. Clerical work will grow only 12.6% over the same period, with clerical employees declining from 17.8% of the labour force to 11.4%. Overall, the CRS finds that the capital costs of significant blue-collar automation are enormous. Largely for that reason, the study suggests that new technologies are unlikely to cause massive unemployment by the year 2000.

The Leontief-Duchin model does not provide the data necessary to test directly the hypothesis that the US workforce is polarising. However, by dividing studied occupations into three tiers, the CRS found that the shares of the US workforce in upper and lower echelon occupations are likely to increase relative to the middle. The change, however, will not be dramatic.

Share of US Workforce	1978	2000
Professionals, managers, proprietors, officials	25.1%	27.0%
Sales, clerical, & craft workers	37.7%	32.9%
Operatives, laborers, farm & service workers	36.2%	40.1%

While such a projection is somewhat useful, it is based upon static job classifications. Some of the most significant changes wrought by workforce technology have altered the wages and skill requirements within occupational categories. In fact, employers often mask changes in the structure of production by retaining old job titles.

The CRS study is a useful introduction to the input/ouput methodology, and its findings are by no means a cover-up. It concludes, "The bottom line of the Leontief-Duchin study seems to be an indication that the US could have the required time to make adjustments found necessary in its human resource policies that affect the American labor force." (Global Electronics, No.60, December 1985)

Advanced technology brings a new drudgery to workplace

London - plugging the office worker into the new technology has been a less than instantaneous process. Managers would like to blame "technophobia", or what they see as the psychological inflexibilities of their staff, but the workers have their reasons, good reasons, for refusing to adjust to the brave new workplace.

The crux of the matter is not so much the computers themselves, but the uses to which they are put in the name of productivity and efficiency - usually with a flimsy apology for consultation with the people who are to use them only after the decision has been made to invest.

It is one thing to be intimidated by the unfamiliar, another to have reservations about the use and implications of the new machines. Many people are only too glad to abandon a toothless typewriter for a shiny new workstation - before the full implications of the new drudgery have had time to sink in.

"Resistance takes place after the technology takes place, after it's been installed," said Stanley Aronowitz, a historian of American labor at the Graduate Center of the City University of New York. "Workers feel at the beginning it's a great boon, and the sales pitch is that work will be made easier without the typewriter and other implements of the ancien regime. Then they find their skills are degraded and the work even more routine than the old routine."

By 1990, the British Trades Unions Congress predicted last week, half of the work force in the Western industrialized countries will be using video display terminals (VDTs) regularly. An estimated 10 million are in use in the United States, where, in the last generation, the growth rate in clerical jobs has been twice that of other sectors.

However, according to Wassily Leontief, a Nobel prize winning economist, "the expansion of automation has a limit", and already a saturation of the market for clerical personnel has been predicted in New York by the end of the decade.

In Britain, labor unions that initially welcomed the potential benefits of computerization are back-tracking and demanding more say in its introduction as they come to realize that more machines have meant less jobs.

An Atlantic Institute survey showed last year that in Europe as a whole the new technology is overwhelmingly perceived as a threat to employment. A few ineffectual provisions regulating the use of VDTs have been enacted by some states on the East Coast of the United States, but only in Scandinavia and FRG have labour agreements on new technology any real weight. Japan adopted guidelines on VDT use last year ...

An International Trade Union Conference on VDTs held in Geneva in 1984 drew up recommendations on screen widths, chair heights and radiation emission for use in negotiation ...

As Mr. Leontief said, "The principal sufferers are middle management, those who shuffle papers - which can be done much more efficiently and accurately by machines." For those clustered on the bottom rungs, the crushing boredom of a job of inputting mounds of empty data, with human contact reduced to a minimum, can hardly be underestimated ... (Herald Tribune, 11 March 1986)

RECENT PUBLICATIONS

UNIDO documents:

UNIDO/IS.574	Trends in Commercialization of Software in Developing Countries by Carlos Correa
UNIDO/IS.597	Guidelines for the Establishment or Redesign of Industrial and Technological Information Services System, Including Selection of Software and Hardware by J. Bankovski and A. Wysocki
UNIDO/IS.605	Guidelines for the Formulation of National Industrial and Technological Information Policies - Based on Indian Experience by N. Seshagiri
UNIDO/IS.609	Applications of Pattern Recognition and Image Processing to Industrial Problems in Developing Countries by TATA Research Development and Design Centre
UNIDO/IS....	Technological Trends in Selected Aspects of Microelectronic Technology and Applications - Custom and Semi-Custom Integrated Circuits and NC Machine Tools by J. Sigurdson
UNIDO/IS.619	A review of the state of the art of GaAs Research by Christopher M. Snowdon
UNIDO/IS.624	Design and Production of Microelectronic Systems and Components by T. Daue and O. Hauck
UNIDO/IS.625	Workshop on Regional Silicon Foundry And Design Centres in the Arab Countries, Report prepared by UNIDO Secretariat in cooperation with Economic and Social Commission for Western Asia (ESCWA)
UNIDO/IS.445 Rev.2	The UNIDO Programme on Technological Advances: Microelectronics. Note prepared by the UNIDO Technology Programme

Economic Commission for Europe:

CE/ENG.AUT/22	Recent Trends in Flexible Manufacturing (Sales No.: E.85.II.E.35)

Information systems for development

The School of Development Studies at the University of East Anglia, Norwich, UK has drawn our attention to some papers which they produced and which may be of interest to our readers:

Electronic information systems analysis: present and future information systems use by academics involved in development studies by Simon Bell (September 1985). This paper was prepared for a workshop of information personnel in British institutions involved with development studies. It

is largely concerned with analysis of a questionnaire which was distributed to academics and information staff involved in Development Studies. The main concern is to look into current use of, and interest in electronic information services, and also to gauge opinion on setting up a database concerned solely with development issues.

Geographic information systems: a review of ILCA's* requirements in relation to the characteristics of existing systems by Simon Bell and Nick Abel. This report concerns itself with computer systems for merging data on pastoral systems research into a common data base within a spatial framework. It studies problems that researchers encounter in receiving, storing, integrating, overlaying, rescaling analysing, modelling, updating and displaying the types and amounts of information required for studies of livestock systems. Geographical information systems have been designed to deal with this kind of problem. The purpose of the paper was to define ILCA's requirements for this type of data-base and to compare these needs with the characteristics of some existing systems. For details on these and similar activities contact: The Director, Overseas Development Group, University of East Anglia, Norwich NR4 7TJ, UK.

A paper called "A practical guide to computing systems evaluation and adoption for users in LDCs: some problems in applying standard techniques" is in preparation.

Production cost in Sri Lanka and Caribbean

The CPA firm of Coopers & Lybrand, apparently under contract to promote offshore assembly, has issued studies of production costs in both Sri Lanka and the English-speaking Caribbean, two areas which have had difficulty attracting investment from US-based electronics firms. In Sri Lanka, hourly direct labor costs in electronics assembly average $.519, based on wages of $.191 per hour. Other costs of labor include training, vacations and holidays, and fringe benefits. Total costs of production, including management salaries, overhead, equipment depreciation, shipping, and the financial costs of carrying inventory, average $6.273 per hour.

Based on a sample product requiring Sri Lankan labor of 45 minutes per piece, Coopers & Lybrand says that a Sri Lankan plant would save 71 per cent on labor and overhead and 35 per cent *overall* (calculating in $17.50 of material per piece).

A similar analysis of a typical plant on the Caribbean island of St. Kitts reports average production wages of $.5527 per hour, with direct labor costs totalling $1.1629 per hour. However, with shipping costs and support for an expatriate managing director lower than for the Sri Lankan example, total production costs average $4.4818 per hour.

Based upon a sample product requiring 5.06 minutes labor per piece, the St. Kitts plant would save 75 per cent on labor and overhead, and 51 per cent overall for a product containing $.667 in materials per piece.

While these studies appear to be based upon relatively reliable cost data, the mix of employees, product costs, etc., are hypothetical. It is likely that the firm chose examples that would highlight cost savings for potential investors. ("Cost Profile of a Typical Electronics Assembly Plant in Sri Lanka" and "Cost Profile of a Typical Electronics/Electro-Mechanical Assembly Plant in the Caribbean") (Global Electronics, December 1985)

Directory of microcomputer software for cost engineering

Directory of Microcomputer Software for Cost Engineering: 1985 Edition. Edited by Calin Popescu and Abdelwahab Kharbani. 1985. 224 pages. $39.75 (US and Canada); $47.50 (All other countries). ISBN: 0-8247-7339.X. (Prices subject to change without notice).

Announcing a convenient reference guide designed to increase your organization's efficiency and productivity! Offering reliable, timely information on microcomputer packages for cost engineering, projects, Directory of Microcomputer Software for Cost Engineering helps you evaluate, identify, and determine the data processing system most suitable to your particular business needs.

Providing an alphabetical listing of over 60 programming packages by name - and supplemented by numerous computer printout samples - this time-saving volume contains practical details on hardware requirements - including the program language used and compatible systems ... software characteristics - including sample computer output and graphic capabilities ... Documentation and training - including available manuals, flow diagrams, and training programs ... ordering - including vendors' names, addresses, phone numbers, and contact persons ... price - including purchasing and possible leasing costs.

Complete with a glossary of microcomputer terms, this Directory gives you quick references - including two reference matrices - offering fingertips access to the important facts you need.

READERSHIP: Cost engineers, building contractors, project and construction managers, cost estimators, planners and schedulers, civil engineers, architects, construction management consultants, construction software consultants, CAD/CAM software designers, microcomputer manufacturers, software producers and vendors, and students in graduate-level construction engineering and management courses. (CRCR, November 1985)

Discount offered on data protection book

The British Computer Society and the National Computing Centre have recently collaborated in producing a booklet on data protection.

Written by Tony Elbra, NCC Data Protection Project Team Leader, the book, 'Implications of the Data Protection Act' considers how the data user or computer bureau will fulfill the requirements of the Act. Both the BCS and the NCC commend this publication as a useful and practical guide to understanding the process of registration under the new legislation.

The booklet is available from NCC Publications, NCC, Oxford Road, Manchester M1 7ED, price £5.95. (Computing the Newspaper, 9 January 1986)

Mind over Machine, by Hubert Dreyfus, professor of philosophy, and his brother, Stuart Dreyfus, professor of industrial engineering and operations research at the University of California, Berkeley. The book explores the effects of the belief that

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* International Livestock Centre for Africa, Addis Ababa, Ethiopia.

people and computers think alike - on business management, education, national defense, medicine, law and society at large. (Macmillan: Free Press, February 1986).

The following is an excerpt of one section of an article which was drawn from the above book and was published in Technology Review, January 1986:

Just how expert are expert systems?

However, human experts seem to have trouble articulating the principles on which they allegedly act. For example, when Arthur Samuel at IBM decided to write a program for playing checkers in 1947, he tried to elicit "heuristic" rules from checkers masters. But nothing the experts told him allowed him to produce master play. So Samuel supplemented these rules with a program that relies blindly on its memory of past successes to improve its current performance. Basically, the program chooses what moves to make based on rules and a record of all past positions.

This checkers program is one of the best expert systems ever built. But it is no champion. Samuel says the program "is quite capable of beating any amateur player and can give better players a good contest". It did once defeat a state champion, but the champion turned around and defeated the program in six mail games. Nonetheless, Samuel still believes that chess champions rely on heuristic rules. Like Feigenbaum, he simply thinks that the champions are poor at recollecting their compiled rules: "The experts do not know enough about the mental processes involved in playing the game."

INTERNIST-1 is an expert system highly touted for its ability to make diagnoses in internal medicine. Yet according to a recent evaluation of the program published in The New England Journal of Medicine, this program misdiagnosed 18 out of a total of 43 cases, while clinicians at Massachusetts General Hospital misdiagnosed 15. Panels of doctors who discussed each case misdiagnosed only 8. (Biopsies, surgery, and post-mortem autopsies were used to establish the correct diagnosis for each case.) The evaluators found that "the experienced clinician is vastly superior to INTERNIST-1, in the ability to consider the relative severity and independence of the different manifestations of disease and to understand the ... evolution of the disease process". The journal also noted that this type of systematic evaluation was "virtually unique in the field of medical applications of artificial intelligence".

In every area of expertise, the story is the same: the computer can do better than the beginner and can even exhibit useful competence, but it cannot rival the very experts whose facts and supposed rules it is processing with incredible speed and accuracy.

Why? Because the expert is not following any rules! While a beginner makes inferences using rules and facts just like a computer, the expert intuitively sees what to do without applying rules. Experts must regress to the novice level to state the rules they still remember but no longer use. No amount of rules and facts can substitute for the know-how experts have gained from experience in tens of thousands of situations. We predict that in no domain in which people exhibit such holistic understanding can a system based on rules consistently do as well as experts. Are there any exceptions?

At first glance, at least one expert system seems to be as good as human specialists. Digital Equipment Corp. developed R1, now call XCON, to decide how to combine components of VAX computers to meet consumers' needs. However, the program performs as well as humans only because there are so many possible combinations that even experienced technical editors depend on rule-based methods of problem solving and take about 10 minutes to work out even simple cases. It is no surprise, then, that this particular expert system can rival the best specialists.

Chess also seems to be an exception to our rule. Some chess programs, after all, have achieved master ratings by using "brute force". Designed for the world's most powerful computers, they are capable of examining about 10 million possible positions in choosing each move.

However, these programs have an Achilles' heel: they can see only about four moves ahead for each piece. So fairly good players, even those whose chess rating is somewhat lower than the computers, can win by using long-range strategies such as attacking the king side. When confronted by a player who knows its weakness, the computer is not a master-level player.

In every domain where know-how is required to make a judgment, computers cannot deliver expert performance, and it is highly unlikely that they ever will.

Those who are most acutely aware of the limitations of expert systems are best able to exploit their real capabilities. Sandra Cook, manager of the Financial Expert Systems Program at the consulting firm SRI International, is one of these enlightened practitioners. She cautions prospective clients that expert systems should not be expected to perform as well as human experts, nor should they be seen as simulations of human expert thinking.

Cook lists some reasonable conditions under which expert, or rather "competent", systems can be useful. For instance, such systems should be used for problems that can be satisfactorily solved by human experts at such a high level that somewhat inferior performance is still acceptable. Processing of business credit applications is a good example, because rules can be developed for this task and computers can follow them as well as and sometimes better than inexperienced humans. Of course, there are some exceptions to the rules, but a few mistakes are not disastrous. On the other hand, no one should expect expert systems to make stock-market predictions because human experts themselves cannot always make such predictions accurately.

Expert systems are also inappropriate for use on problems that change as events unfold. Advice from expert systems on how to control a nuclear reactor during a crisis would come too late to be of any use. Only human experts could make judgments quickly enough to influence events.

It is hard to believe some AI enthusiasts' claim that the companies who use expert systems dominate all competition. In fact, a company that relies too heavily on expert systems faces a genuine danger. Junior employees may come to see expertise as a function of the large knowledge bases and masses of rules on which these programs must rely. Such employees will fail to progress beyond the competent level of performance, and business managers may ultimately discover that their wells of true human expertise and wisdom have gone dry.

Club of Rome publishes new report

The Club of Rome's secretary-general Bertrand Schneider has just published (in French) La Révolution aux pieds-nus (A barefoot revolution), possibly the first global analysis of the phenomenon of non-governmental agencies' interventions in development and the first Club of Rome report since the death of its founder Aurelio Peccei. Synthesizing the results of a vast collective inquiry throughout the third world, it chronicles "the failure of 20 years of development policies" and pinpoints a number of impoverishing characteristics in poor countries: political instability, debt, destruction of ecosystems, dispossession of the peasantry, land reform failures, headlong industrialization, unbridled demographic growth, etc. ...

The author sees the new world phenomenon of NGO initiatives as a possible saviour provided they get more help from authority. He believes the 2bn peasants who currently constitute the world's development stakes require an annual global investment of US$13bn ($6.5 per peasant per year), an eminently attainable objective but as loans, not grants. The Club contends development cannot result from charity but from personal initiatives if the aim is to "raise up the peasants of the Third World by transmitting simple and economic techniques while they rediscover their own culture". Below, secretary-general Schneider replies to questions put to him by Gérard Viratelle in Paris for Development Forum.

The publication of A Barefoot Revolution marks an evolution in the philosophy of the Club of Rome, a wish to renew and relaunch its research work. The Club now has 100 or so members from a whole range of disciplines - scientific, economic, governmental - from 40 countries, a third of them developing. It pursues international research taking account of the interaction of the political, economic, social, cultural, psychological and ecological problems of society and with a long-term perspective. The Reports to, and not from, the Club of Rome aim at an important added value in relation to other studies, says Bertrand Schneider, by securing the participation in its work of influential officials and hoping to see this reflected in decision making. It tries to analyse new problems - thus its current leaning towards "the role of Africa in the world" or its attempt to answer the question "why is the world ungovernable?". (Development Forum, March 1986)

Figure 1

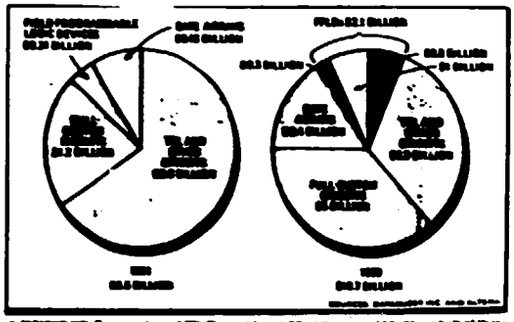

Figure 2

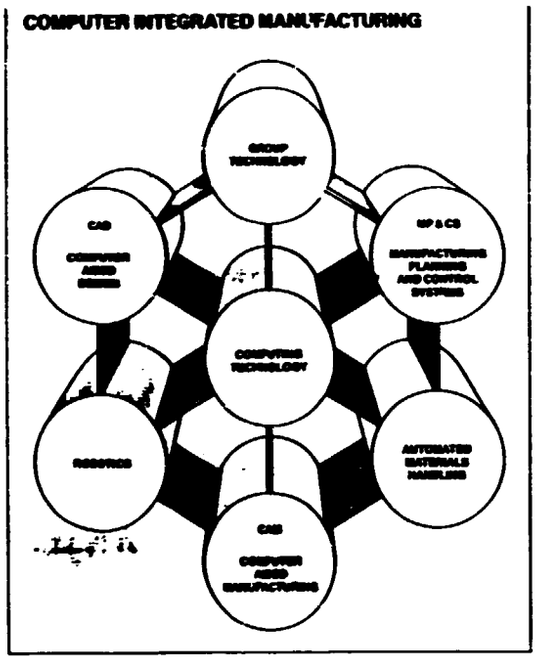

Figure 3

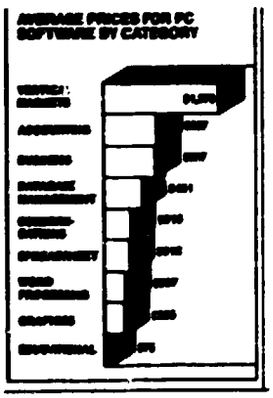

Table 1

ICs STILL SEEM LEAD GaAs GROWTH WORLDWIDE			
Year	Demand for substrates (millions of in.²)	Demand for discrete devices (millions)	Demand for ICs (millions)
1986	5.0	3,172.4	7.2
1986	6.9	3,318.5	12.6
1988 (est.)	8.3	3,441.9	24.1
1987 (est.)	11.9	3,384.3	51.6
1988 (est.)	18.9	3,822.9	126.2

Table 2

ESTIMATED EUROPEAN CMOS CONSUMPTION					
	1986	1987	1988	1989	1990
Total IC Market	$3,755m	$5,935m	$8,488m	$6,778m	$8,229m
Total MOS IC Market	$2,881m	$1,488m	$2,231m	$2,581m	$3,422m
Sub-total CMOS IC Market	$888m	$1,833m	$2,464m	$2,971m	$3,883m
Memory	$281m	$478m	$663m	$862m	$1,128m
Microprocessor	$136m	$276m	$468m	$627m	$816m
Logic	$884m	$884m	$1,198m	$1,482m	$1,823m

Source: Dataquest

Table 3

Changes in employment and attitudes with different types of application in production processes. UK. 1983

Row percentages of the establishments with particular kinds of process application which have experienced gains or losses of jobs, redundancies, union opposition or lack of consultation before introduction.

	BASE		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Control of individual machine or process	598	%	+7	-24	9	8	41
Testing, quality control	263	%	+8	-25	11	8	40
Automated handling	181	%	+6	-28	14	9	38
Central control of several machines or processes	181	%	+6	-32	18	9	32
Design	169	%	+7	-25	12	7	37
Control of individual machine or process and also design	150	%	+6	-27	13	7	35
Control of individual machine or process and also automated handling and testing	85	%	+5	-38	20	8	33
Central control of several machines or processes and also design	57	%	+2	-39	25	7	24
Central control of several machines or processes and also automated handling and testing	49	%	+6	-51	31	8	27
Control of individual machines or processes and also automated handling and testing and design	37	%	+3	-43	30	14	27
Central control of several machines or processes and also automated handling and testing and design	25	%	0	-60	40	12	33

Source: [illegible]

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